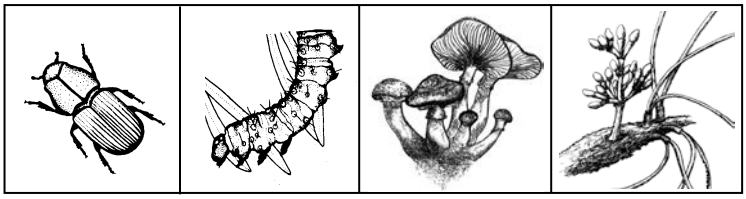
Forest Health Protection



13-06 **May 2013**

Qualitative Assessment of Mountain Pine Beetle Status and Mortality Trends from 2011 to 2012 within 6th-Level Subwatersheds throughout Region 1 with Aerial Survey Data

Joel M Egan, Entomologist, jegan@fs.fed.us, 406-329-3278
Robin Silverstein, GIS Specialist, rsilverstein@fs.fed.us, 406-829-6903
Scott Sontag, Aerial Survey Specialist, ssontag@fs.fed.us, 406-329-3323

Abstract

Mountain pine beetle (MPB) activity has caused extensive pine mortality throughout the Northern Region over the past decade. Outbreak status and trend information has been reported on an annual basis as part of a top-down approach for broad-scale information synthesis. We report on MPB status and trend information with data summarized by aerial detection surveys from 2011 and 2012 through an aggregatory, bottom-up reporting technique. A synopsis of MPB status and trends are provided through a regional perspective that documents surveyed information in a manner that respects data limitations while providing detailed spatial information and broad-scale conclusions.

Overall, MPB-caused mortality continued at a declining rate within the subwatersheds of the Northern Region in 2012 primarily in lodgepole pine host species. MPB status was most active in the Bitterroot, Beaverhead, Deerlodge, and Lewis and Clark Reporting Areas. Trend comparisons were valid for 33% of the subwatersheds surveyed in 2011 and 2012. This number was limited due to special surveys that occurred in eastern portions of the region in 2011. Trend comparisons were valid within many locations in the western and central portion of Region 1 where the vast majority of subwatersheds had a decreased rate of tree mortality. Areas with this decreased trend had a 4.2-fold median rate of decline. Locations that did not match this trend included the Bitterroot and Nez Perce Reporting Areas where numerous subwatersheds had increasing mortality.

Introduction

Forest Health Protection within the USDA Forest Service, Northern Region monitors insect and disease pest activity on an annual basis through aerial survey missions and limited ground surveys. Site-specific, qualitative information from these surveys is important as it is utilized by land managers to support management decisions and it contributes to historical documentation of pest activity. This information has been used to determine broad-scale activity trends for pest species and supplements reporting requirements at the state, regional, and national-levels. Information regarding known pest status and inter-year trends are supplied to resource managers, public officials, and the general public through conditions reports and mass media outlets. Overall, there is a general need for monitoring and documentation of current forest pest activity on an annual basis for consumption by various stakeholders.

Current techniques to assess status and trend information incorporate a top-down approach where large-scale acreage affected and stems killed values are documented at regional, state, and reporting area scales. Benefits of this approach include having a single, concise status and trend message for the entire area being reported upon. Limitations include having a broad message that may not be valid for areas that had limited aerial survey coverage (especially pertaining to trend information) and may not be valid for localized areas due to spatial variations in pest status and trend (for instance different trend in northern portion of the county vs southern, etc.). Additionally, presenting information in this manner implies a single pest event is active for a given species rather than a number of spatially segregated population events that often vary by outbreak stage and/or severity within their unique locations.

Information used for this broad-scale reporting is typically obtained through infrequent, limited ground surveys and aerial survey sketch mapping. Other remote sensing apparatus, such as satellite imagery, have shown promise to detect vegetative change; however, these technologies have not been validated to the point where survey information is obtainable for numerous, often subtle, agent-specific damages that aerial survey technicians can distinguish (Wulder et al., 2006; Meddens et al., 2012). Thus, aerial survey detection missions are the best-available current datasets available for pest status and trend documentation as they provide information on a variety of pest and other damaging agents. However, these data have limitations.

The aerial survey data collected are qualitative in nature and are not validated to the point where standard error rates for measurements can be quantified to support statistical comparisons. Limited quality checks are conducted to ensure that data meets minimum nationally regulated quality standards (see www.fs.fed.us/foresthealth/aviation/qualityassurance.shtml for details).

Error in data estimations can occur within the following areas:

- Spatial extent attributed to damage (point/polygon size or area)
- Spatial location of damage (point/polygon location, spatial location of damage boundary)
- Damage intensity estimated (trees within polygon or per acre for mortality estimates)
- Damage agent attributed (damaging species or abiotic agent)
- Identification of damage where none exists (false positive)
- Failure to identify damage where it does exist (false negative)

As there are limitations in the messaging of top-down informational approach and limitations within the aerial survey data estimations that are qualitative in nature, we propose a bottom-up approach for informational aggregation and reporting that can improve quality and utility of messaging while minimizing the impact of inherent data estimation inaccuracies within the aerial survey data.

The unit recommended for this bottom-up approach is a 6th level or Huc-12 subwatershed (Seaber et al., 1987). Subwatershed boundaries are based on topographic features that dictate water movement. Fine-scale topographic features can impact population dispersal and disturbance levels of certain pest species including bark beetles (de la Giroday et al., 2012; Kaiser et al., 2012); thus, this hydrological unit is beneficial to report bark beetle activity from an ecological standpoint. Additionally, this unit is complementary to recent conditions assessments at a national-level to assess and track changes in subwatershed condition while providing guidance for restoration efforts (USDA FS, 2011).

Vegetation within the units are in close proximity as Huc-12 subwatersheds typically range from 10 to 40 thousand acres or 15 to 62 square miles in spatial extent (see Table 1). This unit is small enough to provide spatially useful information while expansive enough to reduce the importance of certain errors associated with aerial survey data estimations. For instance the spatial location of damage sketch mapped is buffered to the entire subwatershed that it falls within; thus, spatial extent and spatial location of survey errors that exist at the fine spatial scale of a few hundred feet would lose importance at a broader subwatershed scale and errors would be minimized assuming most damage is mapped within the correct subwatershed. This is a reasonable assumption based on a formalized accuracy assessment conducted within Region 2 that indicated buffering the locations of damage attributed to mountain pine beetle (*Dendroctonus ponderosae* Hopkins) (MPB) on the ground by 1500 feet led to a 79% accuracy finding for mapped damage locations (Johnson and Ross, 2008). Conclusions from this study indicate assessments at a coarse spatial scale are reasonable with aerial survey data while fine scale analyses are not (Johnson and Ross, 2008).

Similarly, damage intensity estimates (such as stems affected per unit area) aggregated to total subwatershed-level totals can minimize the importance and influence of individual intensity estimate errors. These values can support trend comparisons over time and convey broad intensity categories (none, low, high) useful for current status reporting. These qualitative categories are beneficial to show how outbreak intensity within a given survey year varies by location.

Benefits of analysis at this scale and bottom-up reporting include being able to document and report current status and trend information at a useful spatial scale while respecting limitations in estimation techniques. Subwatershed information can be aggregated into larger scale boundaries such as lower level watersheds, national forest, reporting area, state, and regional delineations to support reporting and historical documentation for interpretation over a larger spatial extent.

This level of reporting differs from top-down reporting as it can provide precise location detail as to where pest status and inter-year trends differ within a given large-scale boundary. For example, details can be provided that indicate subwatersheds in the northern part of a given

county are having an extensive outbreak while southern subwatersheds are not. This was the case with Ravalli County for 2011 and 2012. Additional benefits include improved reporting on given areas within a large-scale boundary where no status and/or trend information is available due to limited area surveyed. This approach can support broad-scale informational location maps that provide these details in a useful format readily available for user consumption.

Assessment at this subwatershed scale is demonstrated with mountain pine beetle *(Dendroctonus pondersae* Hopkins) status and trend information from 2011 to 2012. This mountain pine beetle is considered one of the most important insects to monitor and document current status and trend information as recent outbreaks have occurred within Region 1 and throughout western North America (Man, 2012).

The objectives of this assessment were to:

1. Assess and document current MPB status within subwatersheds in 2011 and 2012 at a Regional-level
2. Assess and document MPB trend within subwatersheds in 2012 relative to 2011 at a Regional-level
3. Document current MPB status by host species at a Regional-level
4. Determine which Reporting Areas have most active MPB outbreaks at the Reporting area-level
5. Report MPB status and trend information for individual subwatersheds by Reporting area

Methods

Geospatial information used for this analysis included 6th-level, Huc-12 subwatersheds and annual FHP aerial survey damage that were obtained from Regional archives. Data were stored within the Regional geospatial library archive.

Data were largely processed with ESRI® ARCGIS v10.0™ (ESRI, California, USA) and Microsoft Access computer software. A synopsis of data manipulation and mathematical definitions for qualitative categories are provided. Subwatershed boundaries from the national Huc-12 subwatershed data layer were extracted within the Region 1 boundary line to include all subwatersheds that had area at least 150 m within the Region. Then only those subwatersheds that had a pine component were extracted based on Region 1 VMAP v11 and v12 vegetation distributions (Barber et al., 2011) that were supplemented by Landfire vegetation data where gaps existed (pers. comm. J. Weston, 5/20/13). This yielded ~ 4,000 subwatersheds that had a pine component within Region 1 (Table 1; Figure 1).

Table 1. Area within Region 1 Huc-12 Subwatersheds that have Pine Component

Variable	n	Mean	Median	Std Dev	Min	Max
Area (acres)	~ 4,000	22,497	21,246	9,826	4,395	210,613
Area (square miles)	~ 4,000	35	33	15	7	329

Subsequently, surveyed area values were totaled for each subwatershed respectively for the 2011 and 2012 survey years. Attributes from ADS damage dataset layer that indicated MPB activity as the damage causing agent (DCA1, DCA2, and DCA3) were extracted and aggregated into a single dataset. Values were spatially delineated into the subwatersheds that contained them for 2011 and 2012. This led to redelineation of polygons that were located near subwatershed borders and had area within multiple subwatersheds. To control for this edge effect, polygons were segregated into respective subwatersheds, area values were recalculated and intensity values (MPB killed stems per unit area) were calculated by multiplying total acreage per polygon with stems per acre (TPA1, TPA2, or TPA3) values for 2011 and 2012. Host species information was also incorporated to yield intensity values for lodgepole, ponderosa, and limber/whitebark pines. Intensity values were summed for each of these variables within to create aggregate subwatershed totals.

Subwatershed totals were used to calculate the following ratios and categorical variables that are defined in Table 2. Intensity values were delineated to a per subwatershed basis rather than per acre basis due to varied pine host distributions within a given subwatershed. Scaling intensity values by the stems of pine host available at the beginning of the survey year would be ideal; however, this precise information is not readily available without extensive ground surveys. Additionally, a comprehensive validation of stems killed in aerial survey estimates hasn't occurred and precise data is suspect. Thus, absolute rather than relative values are utilized to showcase subwatersheds with broad categories to validly represent MPB activity within their boundaries.

Table 2. Intensity Categories that Indicate MPB Status within Subwatersheds

Variable	Mathematical delineation
None	0 MPB stems killed per subwatershed
Low	1 - 999 stems killed per subwatershed
High	> 1000 stems killed per subwatershed

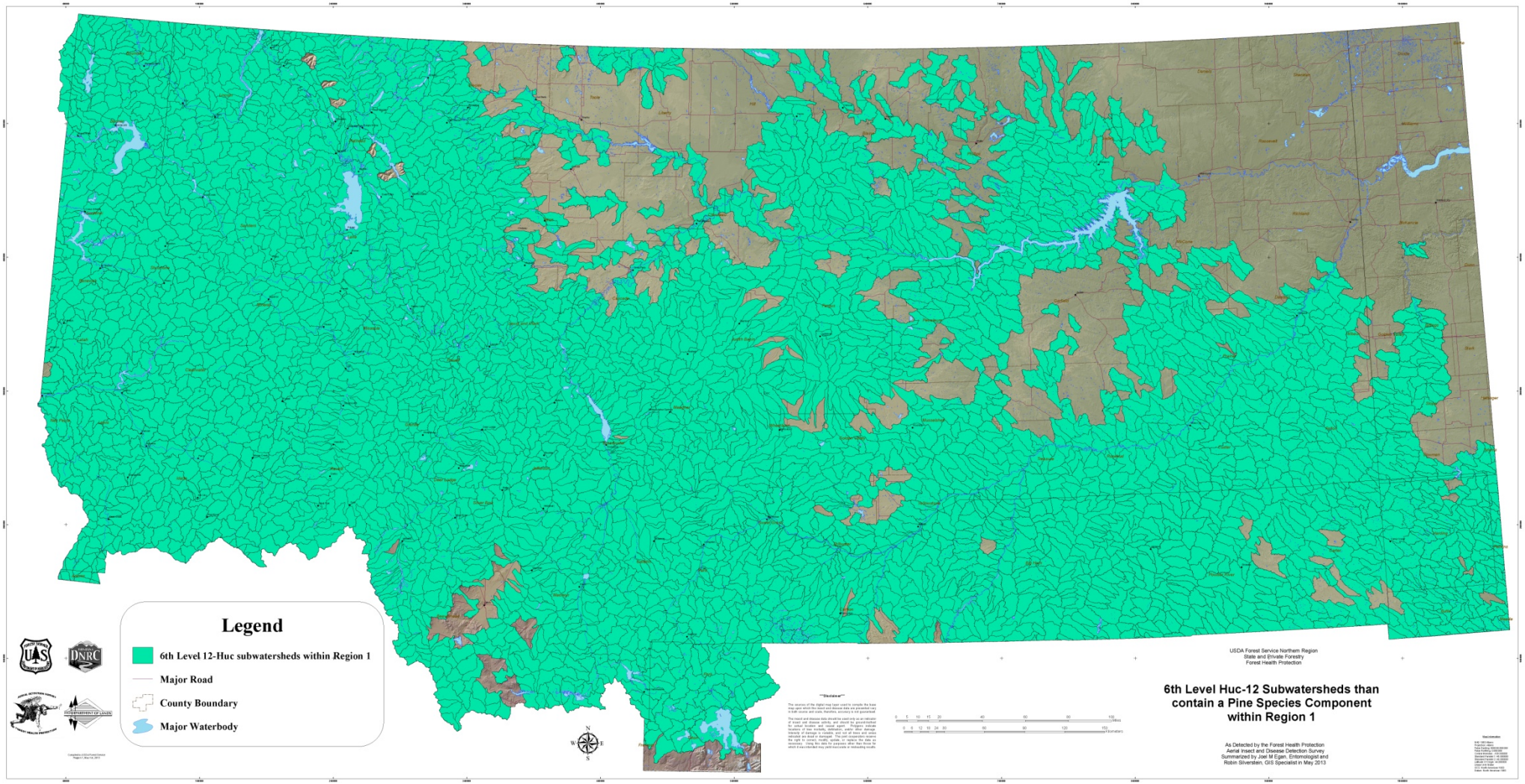
Additional categories for mathematical ratios were constructed to confirm validity to compare trend information from 2011 to 2012. To depict trend information, a ratio was created by dividing MPB stems killed in 2012 by MPB stems killed in 2011 for each subwatershed. This information was calculated for all subwatersheds that had no more than 25% difference in the total amount of area surveyed within each subwatershed between 2011 and 2012. Trend information was interpreted with the categories depicted in Table 3.

Table 3. Categories used to Interpret Trend Information from Ratio of MPB Intensity in 2012 relative to 2011

Trend Category	Mathematical definition
Declining mortality	> 20% decrease in MPB intensity in 2012 vs 2011
Continued mortality	MPB intensity in 2012 within 20% of 2011 values
Increasing mortality	> 20% increase in MPB intensity in 2012 vs 2011

Figure 1. Region 1 Huc-12 Subwatersheds Utilized for MPB Status Summary and Trend Analysis

Note: Subwatersheds included were those that occurred within 150 meters of the Region 1 boundary line and had a component of pine vegetation
n ~ 4000 watersheds within Region 1 that average 22,497 acres or 35 square miles of area



With these definitions, MPB status and trend information can be presented through graphical means and by up-scaling frequency information for subwatersheds to greater geographic extents for reporting. We recommend considering both trend and the MPB status information from 2012 holistically to interpret the significance of MPB activity in a given location. For instance, subwatersheds with decreasing trends and a high MPB intensity status in 2012 indicate mortality levels are declining but are still occurring at significant levels. Subwatersheds with increasing trend that have low MPB intensity status in 2012 may indicate emergent outbreaks or resurgent beetle-caused mortality. Conversely, subwatersheds with increasing trend and high MPB status in 2012 indicate significant and increasing tree mortality.

It should be noted that another limitation with aerial survey data for bark beetle-caused mortality is that it is typically one year behind actual MPB population levels. Thus, status and trend information is useful to indicate mortality levels but should not replace ground surveys for immediate population information. Status and trend information may be very useful to identify locations of interest for further ground surveys.

Results

MPB Status in 2011 and 2012

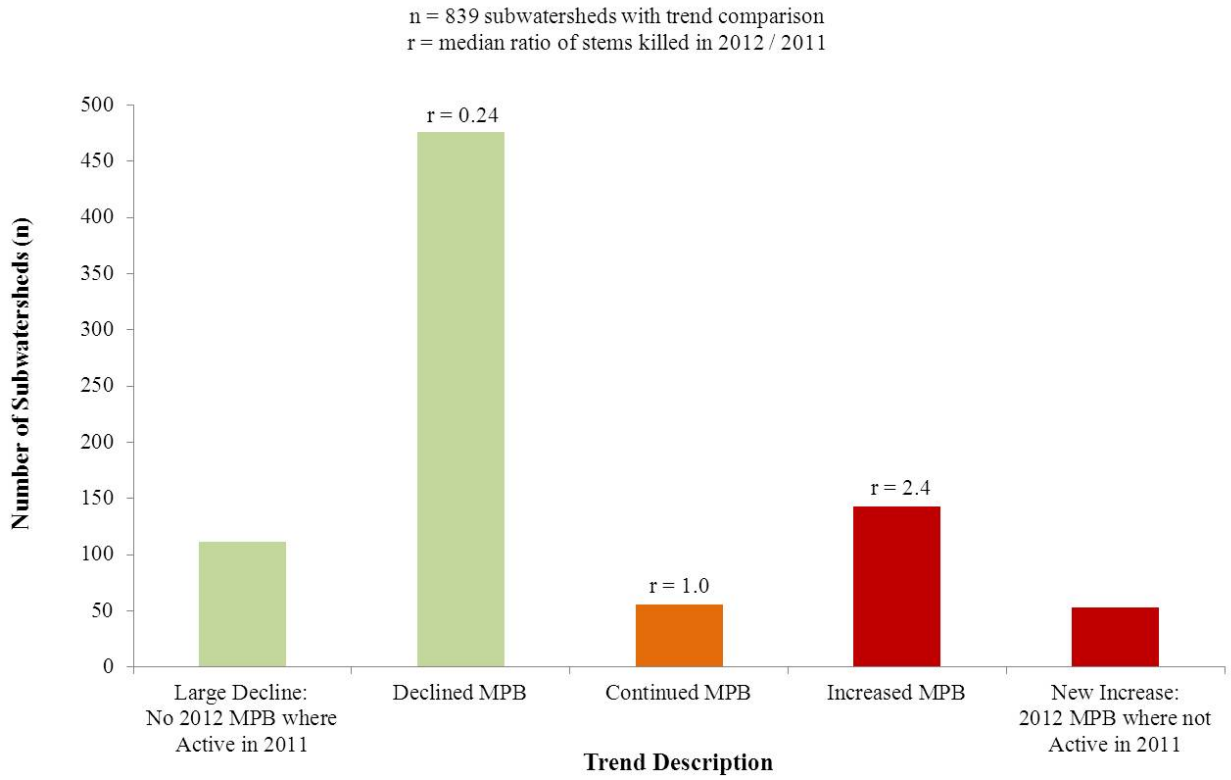
The majority of area surveyed within Region 1 indicated an active MPB status in 2011 (Figures 2 & 5). Subwatersheds with a low intensity of mortality were detected throughout the eastern portion of the Region while the western portion had intermixed low and high intensity (Figure 2). The majority of area surveyed had no MPB activity detected the following year in 2012 (Figures 3 & 5). Eastern portions of the Region weren't surveyed during this year and western portions had intermixed low and high MPB status that varied by location (Figure 3).

MPB Trend: Pine Stems Killed in 2012 Relative to 2011

The majority of subwatersheds surveyed in 2011 or 2012 did not have sufficient overlap to assess trend status. This number was limited due to special surveys that occurred in eastern portions of the Region in 2011 (Figures 4 & 5). Trend status was valid to compare in 33% of the subwatersheds surveyed in 2011 or 2012. Where comparisons were valid within central and western portions of the region, the vast majority of locations surveyed had a decreased rate of mortality (Figure 4 & 5). 19% of the subwatersheds that showed decline had no MPB activity in 2012 indicating outbreaks likely ended in these locations. The rate of decline within subwatersheds that did have 2012 activity indicated an estimated 4.2-fold decline in mortality levels (Chart 1). A few sporadic subwatersheds had MPB activity estimated at similar intensity levels in 2011 and 2012 and various locations in the western portion of the region had no MPB activity in either 2011 or 2012.

Subwatersheds with an increasing mortality trend were sporadically located throughout the central and western portions of the region with a median rate of increase of 2.4-fold (Figure 4; Chart 1). 27% of subwatersheds that increased did so in locations with no prior MPB activity detected in 2011 and were located in the western and northwestern portions of the Region. This may indicate emerging outbreaks in those areas and further ground checks are recommended.

Chart 1. Subwatersheds within Region 1 Categorized by Mountain Pine Beetle Trend in 2012 compared to 2011



Areas that had a high intensity MPB status in 2012 were separated out to indicate trend information as these locations represented a significant level of damage observed in 2012. In majority of these subwatersheds, MPB trend information indicated decreasing mortality (Figure 6).

MPB Status in 2012 by Host Species

The vast majority of MPB activity estimated from aerial surveys in 2012 occurred within lodgepole pine host type (Figure 7). Ponderosa pine mortality occurred throughout the surveyed area to a lesser extent, especially within subwatersheds in the Bitterroot valley and in the Divide, Elkhorn, and Little Belt Mountains east of the continental divide (Figure 8). None to limited limber and whitebark pine mortality occurred in the western portions of the Region in Idaho and northwest Montana (Figure 9). Limber and whitebark pine mortality occurred throughout western and central Montana in 2012. Interestingly, MPB status within five-needled pine hosts was greater than other pine host damage in central Montana within Gallatin Canyon and near the Paradise valley (Figure 9). This indicates possible refugia populations within this host type as previous MPB activity declined sharply within lodgepole pines in recent years.

MPB Status and Trend by Reporting Area

Reporting Areas are broad locations of interest that encompass all federal, state, and private land ownerships within a particular geographic boundary. MPB status and trend for all host species was assessed for each Reporting Area in the Northern Region (Figure 10) by aggregating individual subwatershed frequency information. Reporting Areas survey information and comparisons are presented in Tables 4 & 5. Detailed MPB status and trend information, including a list of subwatersheds that had a high intensity MPB status in 2012 with trend information (where available) is presented for each Reporting Area in Appendix B.

Estimated MPB-caused mortality was greatest within the Bitterroot, Beaverhead, Deerlodge, and Lewis and Clark Reporting Areas as they had high proportion subwatersheds with a high intensity MPB status in 2012 (Table 5). Of those areas, the Bitterroot and Deerlodge had many watersheds with increased mortality trend in 2012 while the Beaverhead and Lewis and Clark had mostly declining trends. The Nez Perce reporting area had a high proportion of subwatersheds with an increasing mortality trend although most of these had low intensity MPB status (Table 5). This may indicate resurgent mortality in subwatersheds that had little MPB activity in 2011 or emergent outbreaks within the Nez Perce reporting area in 2012 and further ground checks are recommended.

Conclusion

Overall, MPB-caused mortality continued at a declining rate within the subwatersheds of Region 1 in 2012 primarily in lodgepole pine host species. A far greater number of subwatersheds with no MPB activity were observed in 2012 compared to 2011. The number of subwatersheds with high and low MPB status levels decreased during this time period as well. The few subwatersheds with high intensity MPB status in 2012 were intermixed throughout central and western portions of the Region. The Bitterroot, Beaverhead, Deerlodge, and Lewis and Clark Reporting Areas had the greatest levels of ongoing MPB activity in 2012.

Trend comparisons were valid for 33% of the watersheds surveyed in 2011 and 2012. This number was limited as many of the subwatersheds in eastern Montana had special surveys in 2011 but not 2012. Where trend comparisons were valid, the vast majority of locations that were surveyed in both 2011 and 2012 indicated a declining mortality trend. Mortality levels declined at a median rate of 4.2-fold in these subwatersheds. Locations that did not match this trend included the Bitterroot and Nez Perce Reporting Areas where many of subwatersheds had increasing mortality. Trends are not available for large portions of the Beaverhead, Deerlodge, Lewis and Clark, and Gallatin Reporting Areas due to limited survey overlap in 2011 and 2012. See Figure 4 for site-specific trend information across Region 1.

Figure 2. Huc-12 Subwatersheds with Mountain Pine Beetle Outbreaks that Varied by Intensity in 2011 throughout Region 1

Note: Red indicates subwatersheds w/ high levels of MPB activity in 2011 as defined by estimations of >1000 stems/subwatershed killed

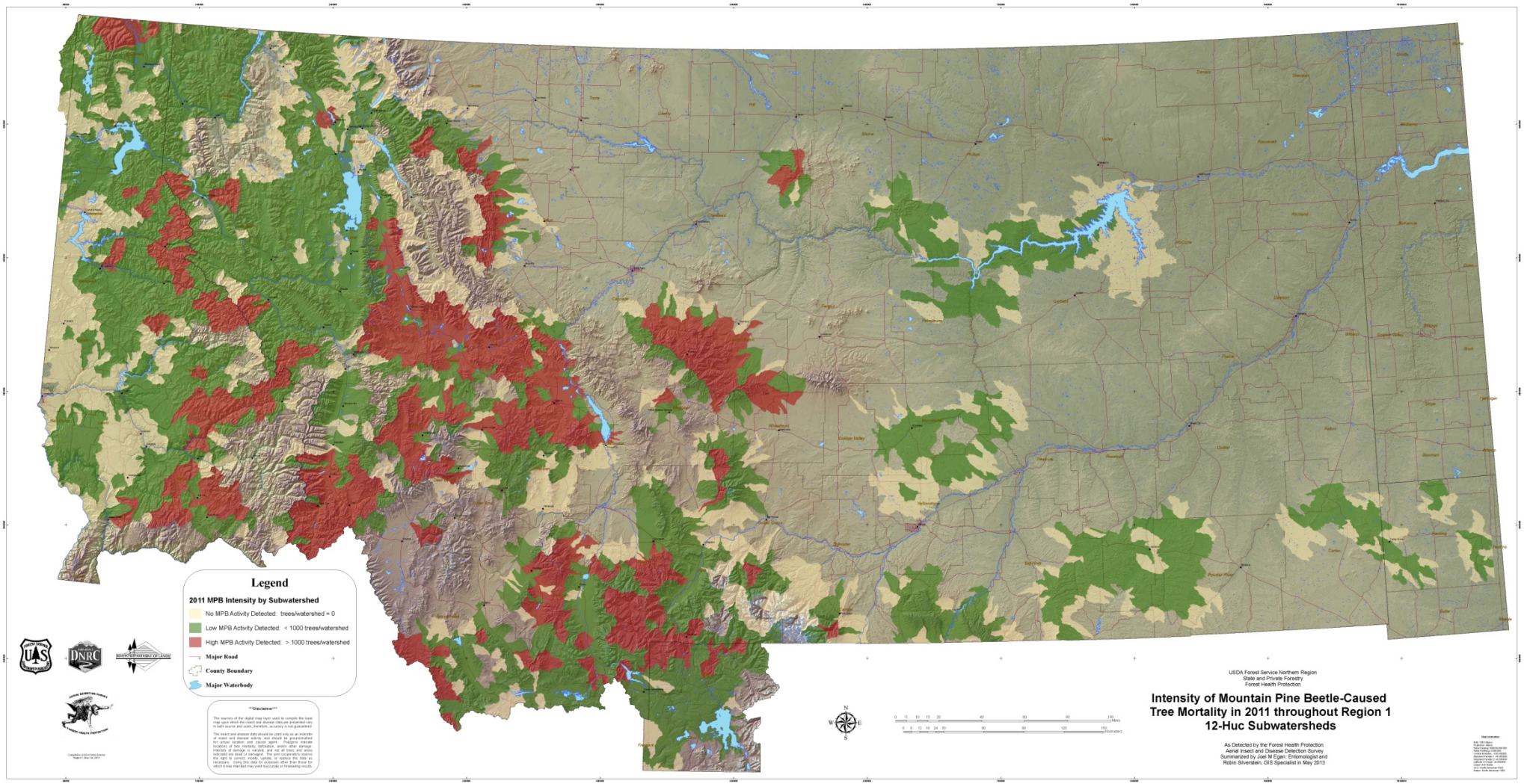


Figure 3. Huc-12 Subwatersheds with Mountain Pine Beetle Outbreaks that Varied by Intensity in 2012 throughout Region 1

Note: Red indicates subwatersheds with high levels of MPB activity as defined by mortality estimations exceeding 1000 stems killed per subwatershed

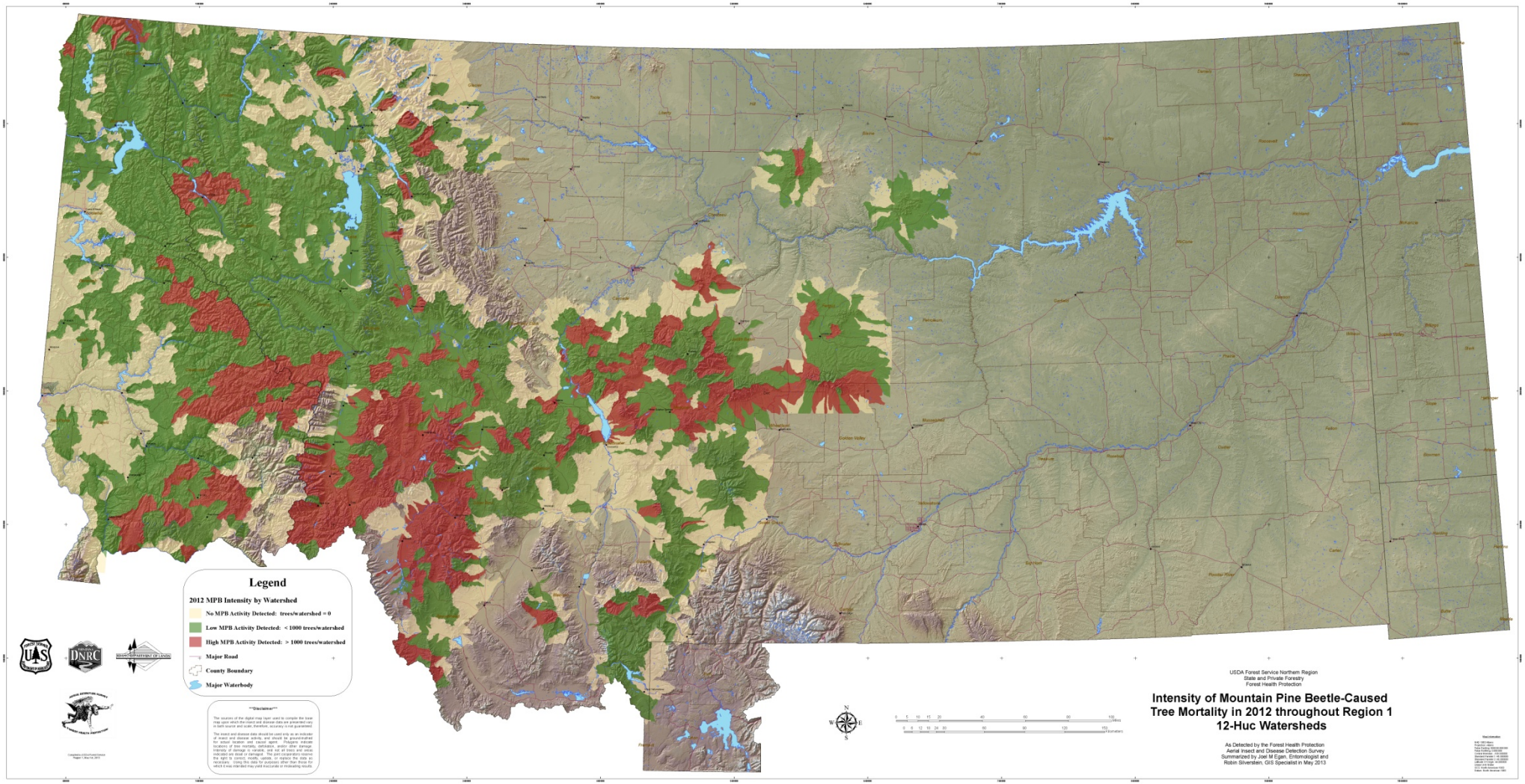


Figure 4. Trend in Mountain Pine Beetle Status in 2012 Compared to 2011 within Huc-12 Subwatersheds throughout Region 1

Note: Teal and red indicate subwatersheds where MPB-caused stem mortality estimates respectively decreased and increased in 2012 relative to 2011

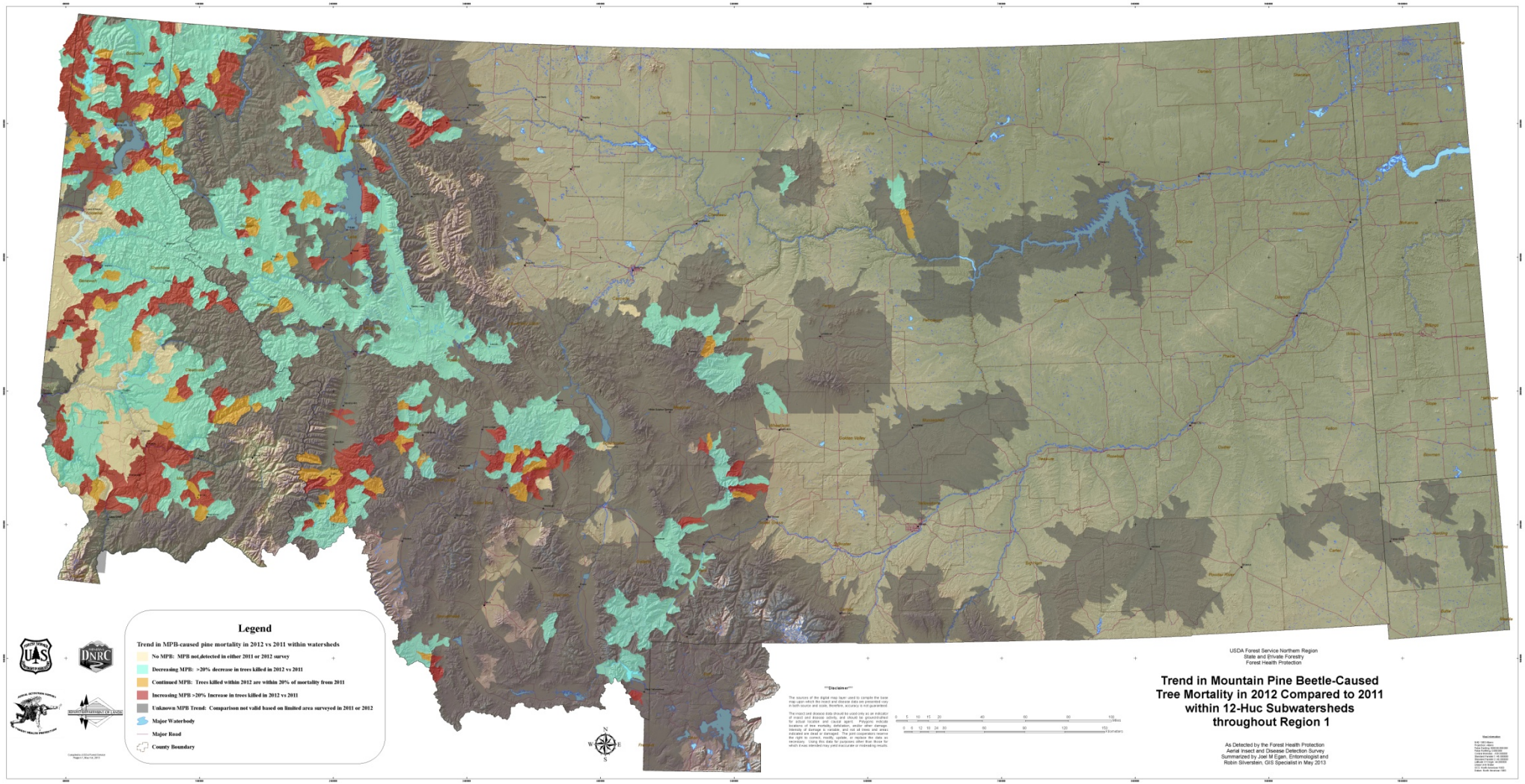


Figure 5. Region 1 Mountain Pine Beetle Status within Huc-12 Subwatersheds

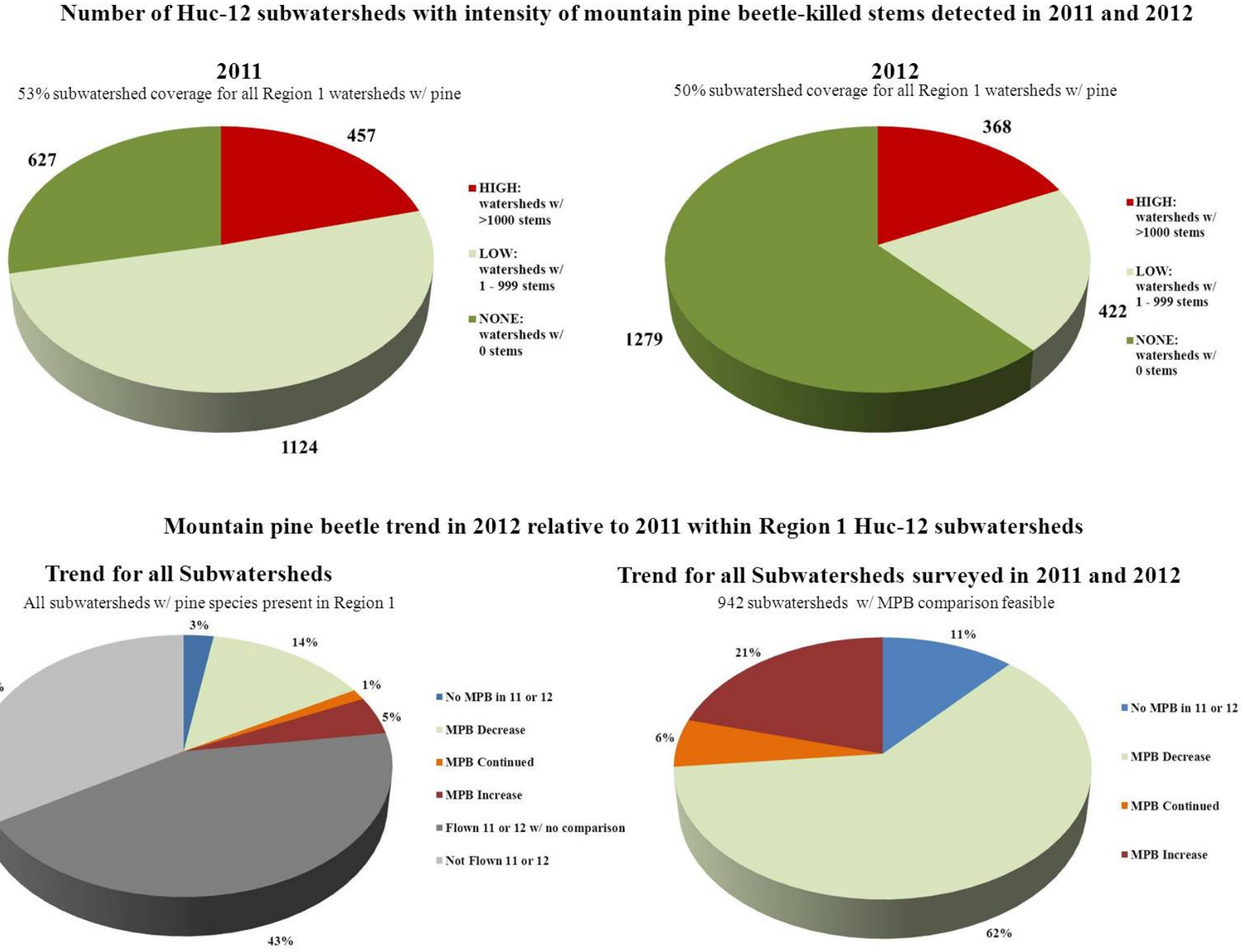


Figure 6. Trend in Mountain Pine Beetle Status in 2012 Compared to 2011 within Huc-12 Subwatersheds that had a High Intensity Status in 2012 within Region 1

Note: Teal and red indicate watersheds where MPB-caused stem mortality estimates respectively decreased and increased in 2012 relative to 2011

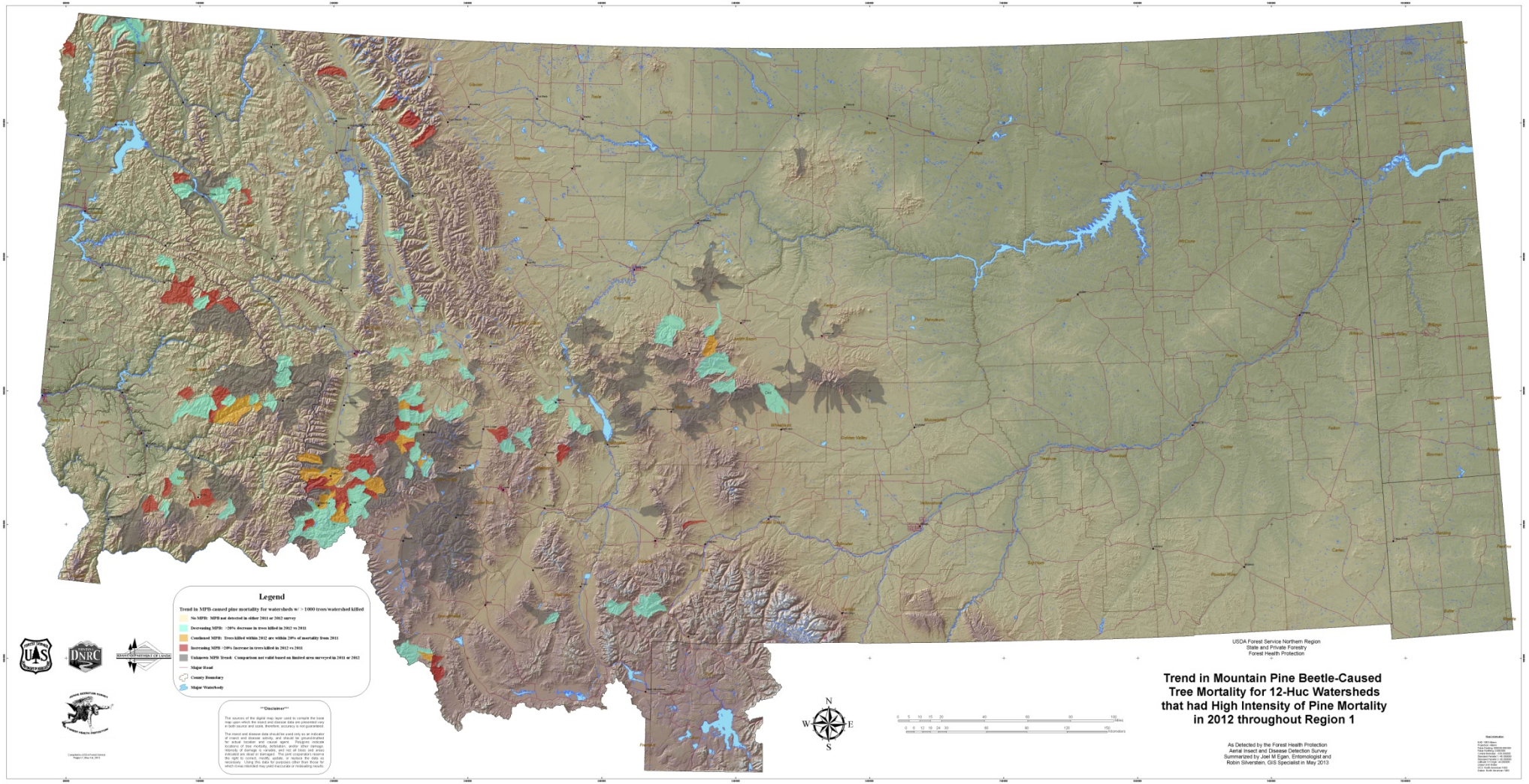


Figure 7. MPB Status within Lodgepole Pine Host Species as Detected from 2012 Aerial Survey Mission throughout Region 1

Note: Pink indicates watersheds w/ high levels of estimated MPB activity as defined by 1000-4999 stems killed per subwatershed
Dark red indicates very high levels of estimated mortality as defined by > 5000 stems killed per subwatershed

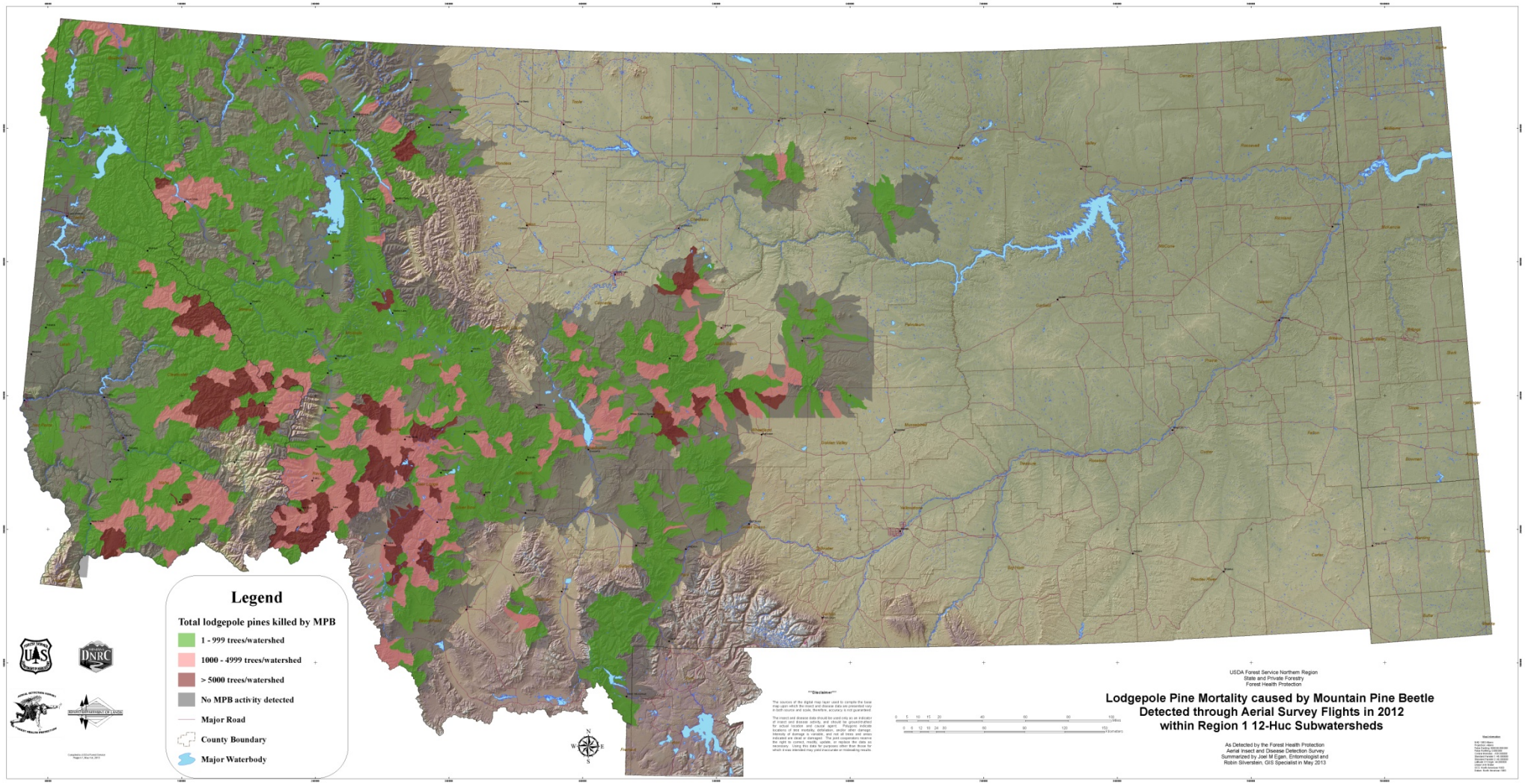


Figure 8. MPB Status within Ponderosa Pine Host Species as Detected from 2012 Aerial Survey Mission throughout Region 1

Note: Pink indicates watersheds w/ high levels of estimated MPB activity as defined by 1000-4999 stems killed per subwatershed
Dark red indicates very high levels of estimated mortality as defined by > 5000 stems killed per subwatershed

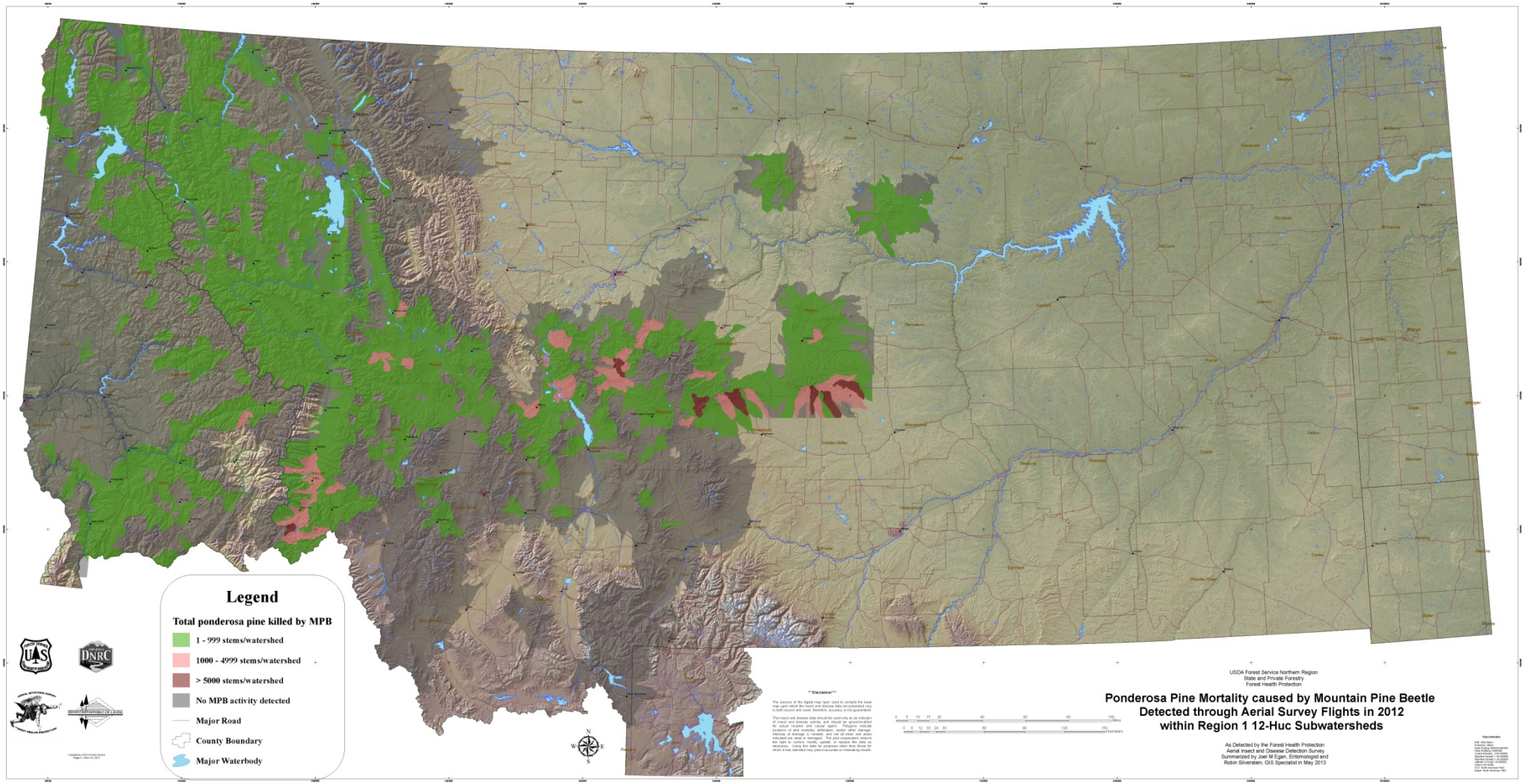
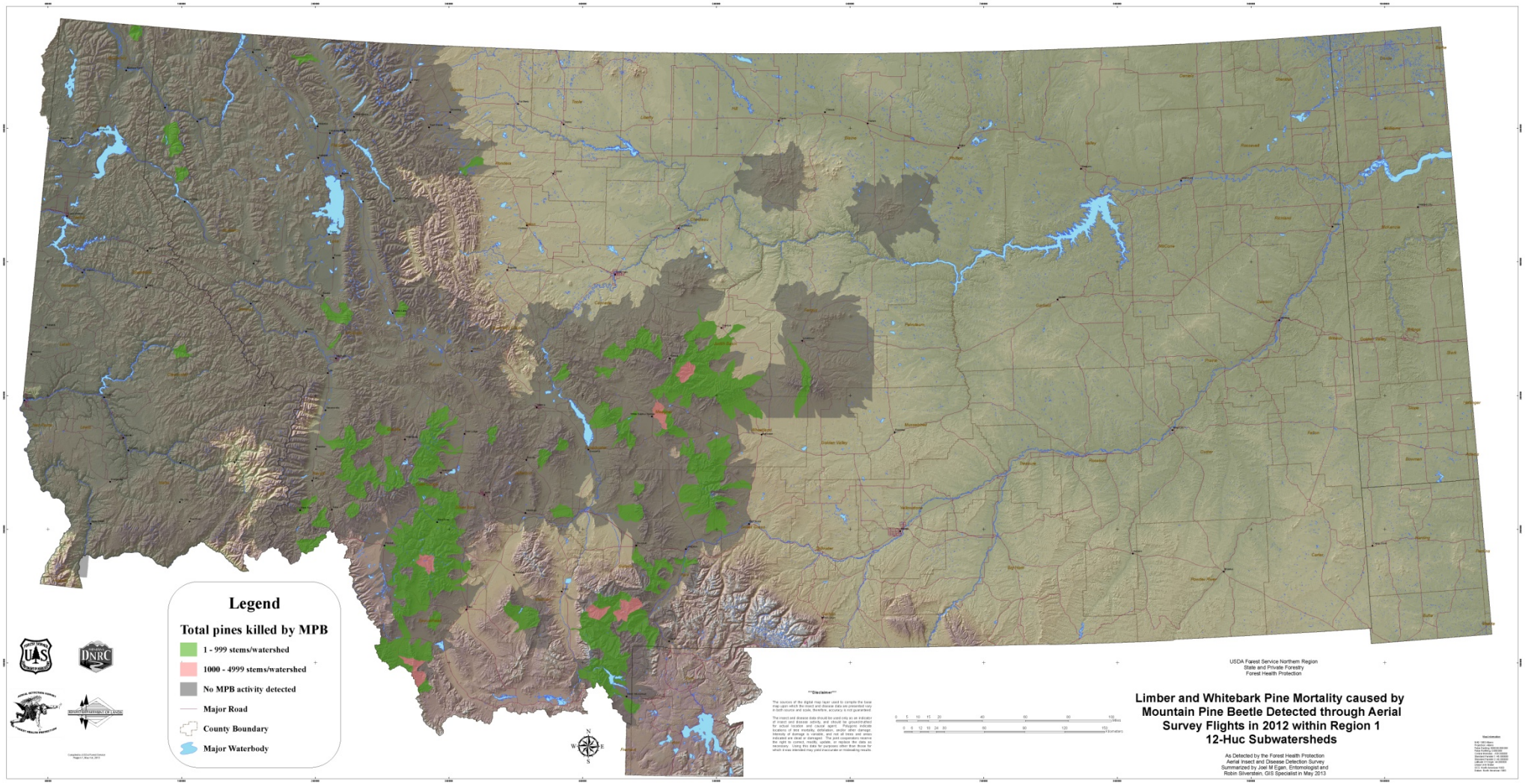


Figure 9. MPB Status within Limber and Whitebark Pine Host Species as Detected from 2012 Aerial Survey Mission throughout Region 1

Note: Pink indicates watersheds w/ high levels of estimated MPB activity as defined by 1000-4999 stems killed per subwatershed
Dark red indicates very high levels of estimated mortality as defined by > 5000 stems killed per subwatershed



Works cited

Barber, J., Bush, R., Bergland, D. 2011. The Region 1 Existing Vegetation Classification System and its Relationship to Region 1 Inventory Data and Map Products. Vegetation Classification, Mapping, Inventory and Analysis Numbered Report 11-10. USDA Forest Service, Northern Region, Missoula, MT. 39p.

de la Giroday, H.-M. C., Carroll, A. L. and Aukema, B. H. 2012. Breach of the northern Rocky Mountain geoclimatic barrier: initiation of range expansion by the mountain pine beetle. Journal of Biogeography, 39: 1112–1123.

Kaiser, K. E., McGlynn, B. L. and Emanuel, R. E. (2012), Ecohydrology of an outbreak: mountain pine beetle impacts trees in drier landscape positions first. Ecohydrolology. 1286

Man, G. 2012. Major forest insect and disease conditions in the United States: 2011. FS–1000. USDA Forest Service, Forest Health Protection, Washington, DC. 40 p.

Meddens A J H, Hicke J A and Ferguson C A 2012 Spatial and temporal patterns of observed bark beetle-caused tree mortality in British Columbia and the western US Ecol. Appl. 22 1876–91.

Seaber, P.R., Kapinos, F.P., Knapp, G.L. 1987. Hydrologic units maps. Water-Supply Paper # 2294. United States Geological Survey, Denver, CO. 63 p.

U.S. Department of Agriculture (USDA) Forest Service. 2011. Watershed Condition Framework. FS-977. Washington, DC: U.S. Department of Agriculture, Forest Service. 34 p.

Weston, John. GIS Specialist, Northern Region. 5/20/13: Verbal Communication.

Wulder, M. A., Dymond, C. C., White, J. C., Leckie, D. G. & Carroll, A. L. 2006. Surveying mountain pine beetle damage of forests: a review of remote sensing opportunities. For. Ecol. Manage. 221, 27–41.

Citation for this report

Egan, J., Silverstein, R., Sontag, S. 2013. Qualitative Assessment of Mountain Pine Beetle Status and Mortality Trends from 2011 to 2012 within 6th-Level Subwatersheds throughout Region 1 with Aerial Survey Data. FHP Numbered Report 13-06. U.S. Department of Agriculture, Forest Service, Forest Health Protection, Missoula, MT. 54 p.

Figure 10. Reporting Area Boundary Delineations within Region 1

Table 4. Survey Information for Region 1 Huc-12 Watersheds in 2011 and 2012 by Reporting Area

Note: A Huc-12 watershed is considered to be within a Reporting Area if it exists 150 meters inside of a Reporting Area boundary; thus, a single watershed may provide information for multiple Reporting Areas

Reporting Area	Percent of pine watersheds surveyed in 2011 or 2012	Percent of pine watersheds surveyed in 2011	Percent of pine watersheds surveyed in 2012
Beaverhead	97%	67%	49%
Bitterroot	86%	75%	80%
Blackfeet IR	77%	23%	77%
Clearwater	99%	84%	99%
Coeur d'Alene	100%	100%	100%
Coeur d'Alene IR	100%	100%	100%
Crow IR	35%	35%	0%
Custer	40%	40%	0%
Deerlodge	94%	73%	91%
Flathead	92%	81%	90%
Flathead IR	100%	97%	100%
Fort Belknap IR	37%	27%	23%
Fort Peck IR	8%	8%	0%
Gallatin	89%	72%	64%
Garnet	100%	88%	100%
Glacier NP	100%	76%	100%
Helena	100%	55%	92%
Kaniksu	100%	100%	100%
Kootenai	100%	75%	100%
Lewis and Clark	71%	35%	60%
Lolo	99%	90%	99%
Nez Perce	82%	53%	82%
Nez Perce IR	97%	96%	97%
Northern Cheyenne IR	57%	57%	0%
Rocky Boys IR	35%	20%	35%
St. Joe	100%	98%	100%
Yellowstone NP	93%	93%	21%

Table 5. Survey Information for Region 1 Huc-12 Watersheds for Increasing and Active MPB Watersheds by Reporting Area

Note: Reporting Areas that have percent increasing trend or high intensity MPB relative values that exceed ~ 1/4th of all watersheds in reporting area are highlighted to indicate areas of concern for further MPB activity

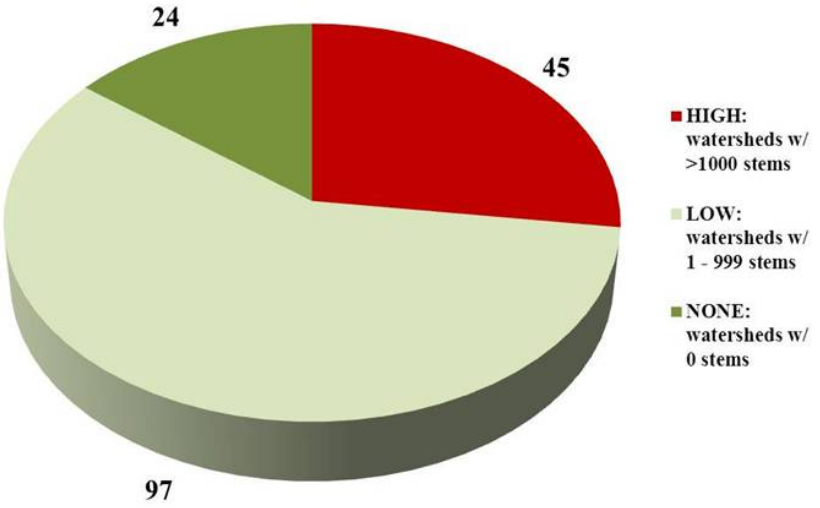
Reporting Area	Percent of subwatersheds where trend comparison is valid	Percent of watersheds w/ trend info that show increasing MPB	Percent of all watersheds surveyed in 2012 with high intensity MPB
Beaverhead	5%	15%	40%
Bitterroot	38%	42%	57%
Blackfeet IR	6%	33%	0%
Clearwater	65%	14%	21%
Coeur d'Alene	92%	13%	0%
Coeur d'Alene IR	100%	9%	0%
Crow IR	0%	0%	No 2012 Survey
Custer	0%	0%	No 2012 Survey
Deerlodge	35%	32%	36%
Flathead	50%	23%	3%
Flathead IR	61%	15%	0%
Fort Belknap IR	3%	0%	0%
Fort Peck IR	0%	0%	No 2012 Survey
Gallatin	19%	15%	4%
Garnet	48%	0%	15%
Glacier NP	42%	32%	7%
Helena	18%	7%	17%
Kaniksu	93%	41%	6%
Kootenai	43%	27%	7%
Lewis and Clark	8%	10%	24%
Lolo	65%	4%	13%
Nez Perce	36%	50%	20%
Nez Perce IR	87%	22%	0%
Northern Cheyenne IR	0%	0%	No 2012 Survey
Rocky Boys IR	4%	0%	6%
St. Joe	83%	23%	20%
Yellowstone NP	3%	0%	0%

Appendix A. Beaverhead Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

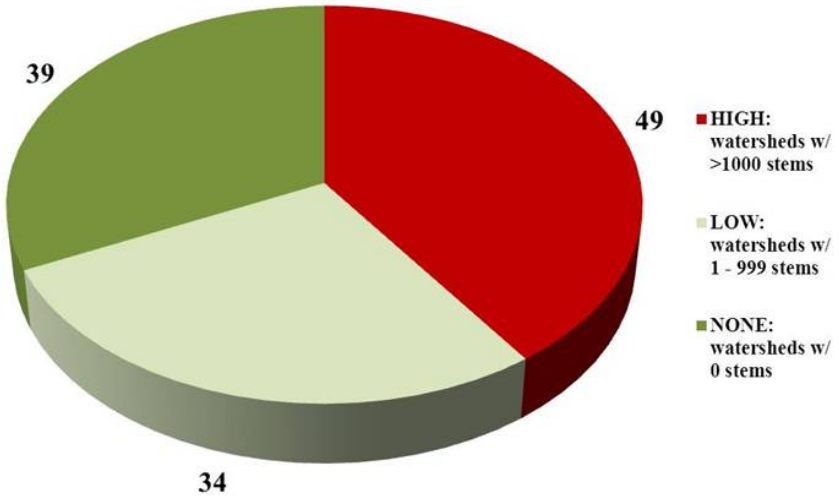
2011

67% subwatershed coverage within reporting area

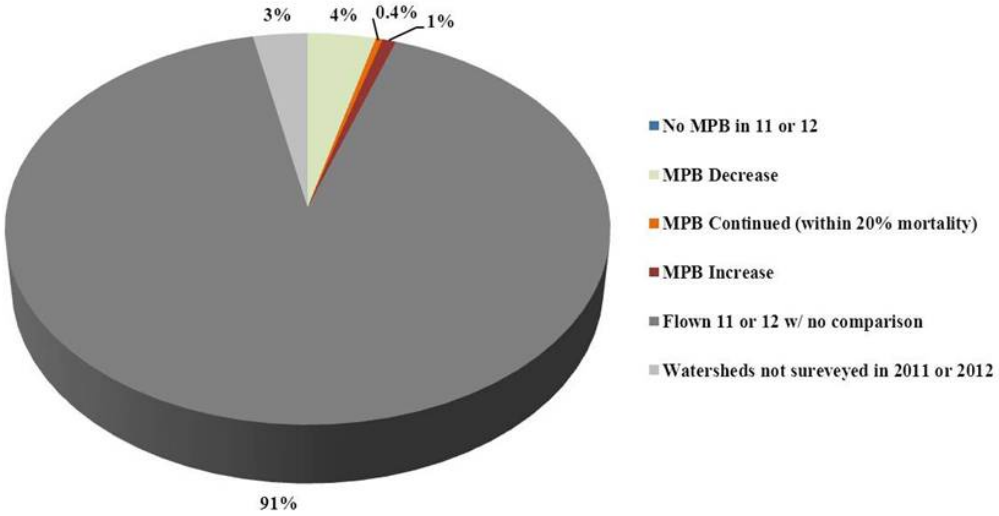


2012

49% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Dad Creek-Medicine Lodge Creek	Increasing
Schwartz Creek	Increasing
Bear Creek	Decreasing
Black Canyon Creek	Decreasing
Greenhorn Creek	Decreasing
Jeff Davis Creek-Horse Prairie Creek	Decreasing

Additional subwatersheds on next page

Beaverhead Reporting Area

MPB trend in 2012 relative to 2011 within Huc-12 subwatersheds that had High MPB intensity detected in 2012

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Bear Creek-Big Hole River	Unknown
Birch Creek	Unknown
Bryant Creek	Unknown
Bull Creek	Unknown
Canyon Creek	Unknown
Cherry Creek	Unknown
Francis Creek	Unknown
French Creek	Unknown
Headwaters Grasshopper Creek	Unknown
Headwaters Wise River	Unknown
Jerry Creek	Unknown
Lacy Creek	Unknown
Lake Creek-Grasshopper Creek	Unknown
Lower Warm Springs Creek	Unknown
Lower Wise River	Unknown
McVey Creek	Unknown
Meadow Creek-Big Hole River	Unknown
Middle Rattlesnake Creek	Unknown
Middle Wise River	Unknown
North Branch Big Swamp Creek-Big Hole River	Unknown
Quartz Hill Gulch-Big Hole River	Unknown

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

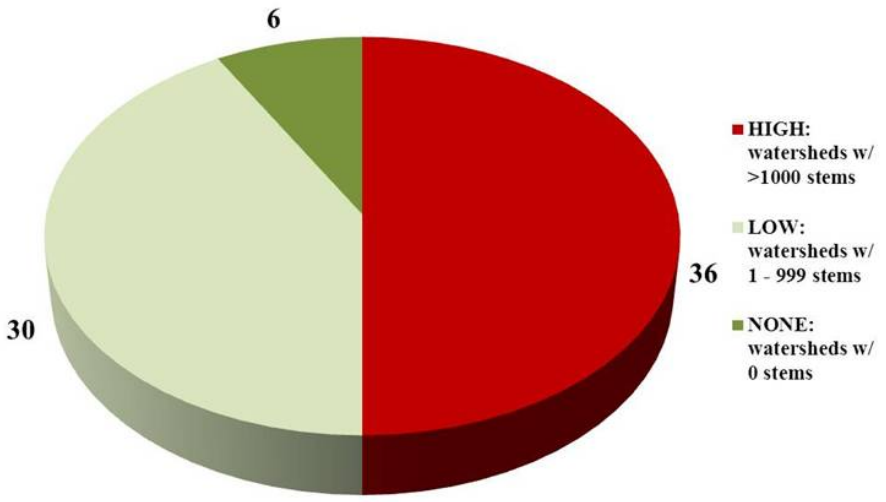
Huc-12 Subwatershed	Trend
Rock Creek	Unknown
Salefsky Creek-Big Hole River	Unknown
Stanley Creek	Unknown
Steel Creek	Unknown
Toomey Creek-Big Hole River	Unknown
Town of Wisdom-Big Hole River	Unknown
Trapper Creek	Unknown
Upper Governor Creek	Unknown
Upper Rattlesnake Creek	Unknown
Upper Wise River	Unknown
Wyman Creek	Unknown
Alder Creek	Unknown
California Creek	Unknown
Christiansen Creek	Unknown
Deep Creek	Unknown
Doolittle Creek	Unknown
Lower Pettengill Creek	Unknown
Middle Pettengill Creek	Unknown
Trail Creek	Unknown
Upper Pettengill Creek	Unknown
Puller Hot Springs-Ruby River	Unknown

Bitterroot Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

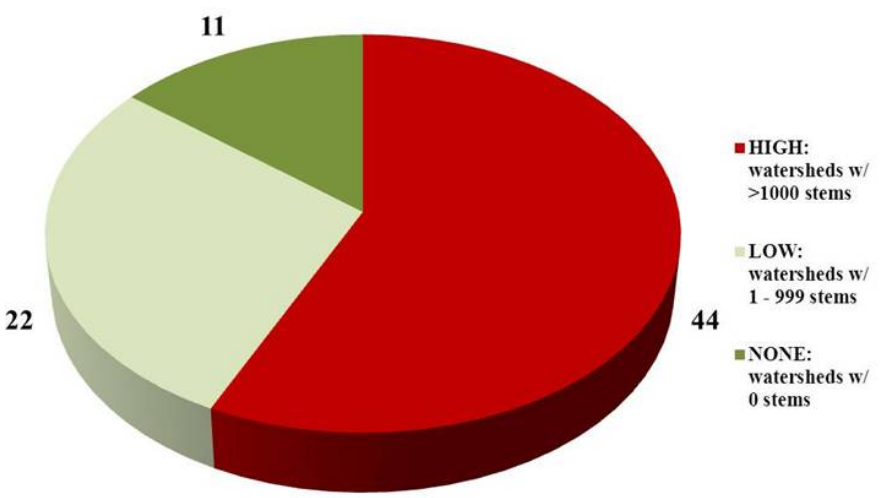
2011

75% subwatershed coverage within reporting area

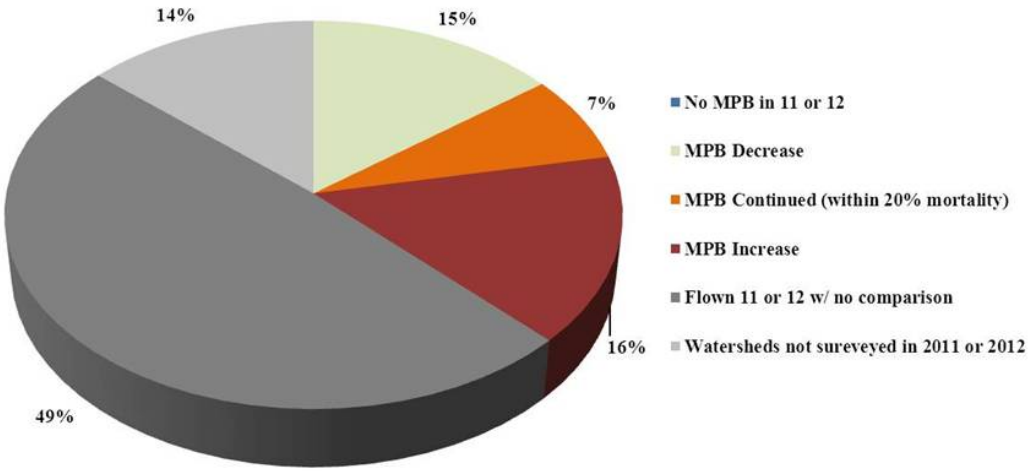


2012

80% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Bitterroot River-Chaffin Creek	Increasing
E Fork Bitterroot-Bartie Lord Creek	Increasing
E Fork Bitterroot-Laird Creek	Increasing
Lower Blue Joint Creek	Increasing
Middle Skalkaho Creek	Increasing
Middle Sleeping Child Creek	Increasing
Tin Cup Creek	Increasing
Upper Rye Creek	Increasing
Upper Skalkaho Creek	Increasing

Additional subwatersheds on next page

Bitterroot Reporting Area

MPB trend in 2012 relative to 2011 within Huc-12 subwatersheds that had High MPB intensity detected in 2012

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Cameron Creek	Decreasing
Camp Creek	Decreasing
Divide Creek	Decreasing
E Fork Bitterroot-Jennings Camp Creek	Decreasing
Hughes Creek	Decreasing
Nez Pierce Fork-Nelson Lake	Decreasing
Overwhich Creek	Decreasing
Piquette Creek	Decreasing
Slate Creek	Decreasing
Tolan Creek	Decreasing
Upper Blue Joint Creek	Decreasing
Upper Sleeping Child Creek	Decreasing
W Fork Bitterroot-Mud Creek	Decreasing
W Fork Bitterroot-Painted Rock Lake	Decreasing

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

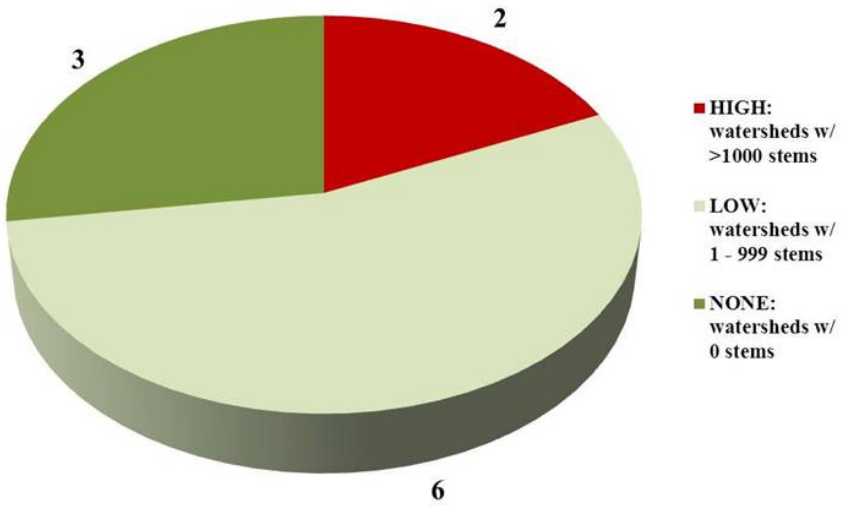
Huc-12 Subwatershed	Trend
Sawtooth Creek	Unknown
Bitterroot River-Lick Creek	Unknown
Deer Creek	Unknown
East Fork Bitterroot River-Clifford Creek	Unknown
Little West Fork	Unknown
Lower Burnt Fork Bitterroot River	Unknown
Meadow Creek	Unknown
Sheephead Creek	Unknown
South Lost Horse Creek	Unknown
Threemile Creek	Unknown
Trapper Creek	Unknown
Upper Burnt Fork Bitterroot River	Unknown
Watchtower Creek	Unknown
Willow Creek	Unknown

Blackfeet Indian Reservation Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

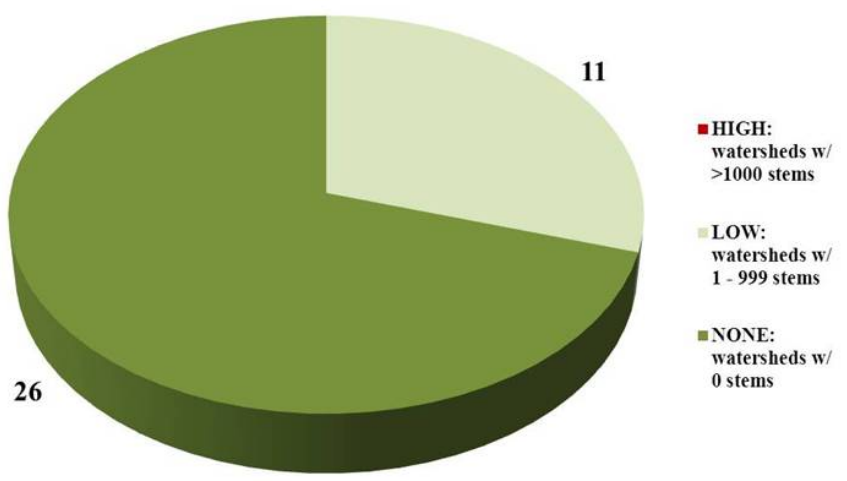
2011

23% subwatershed coverage within reporting area

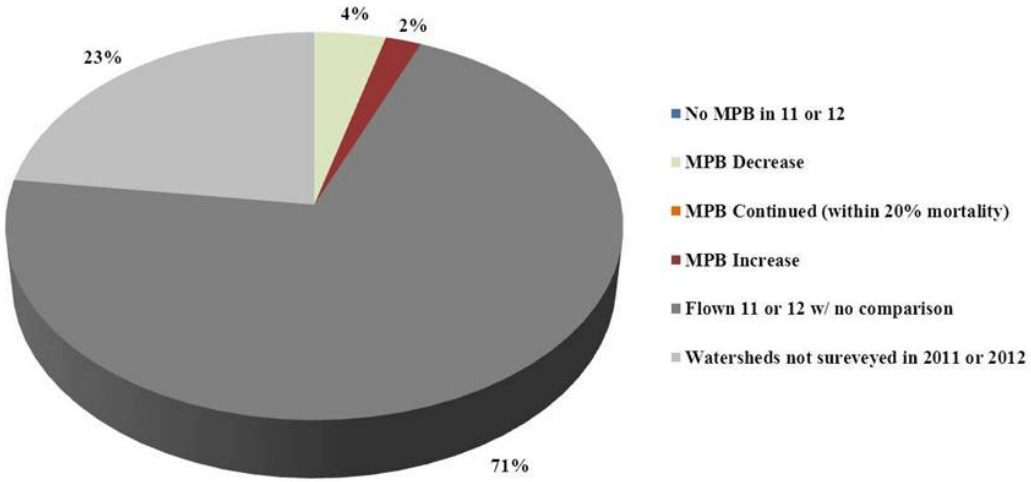


2012

77% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

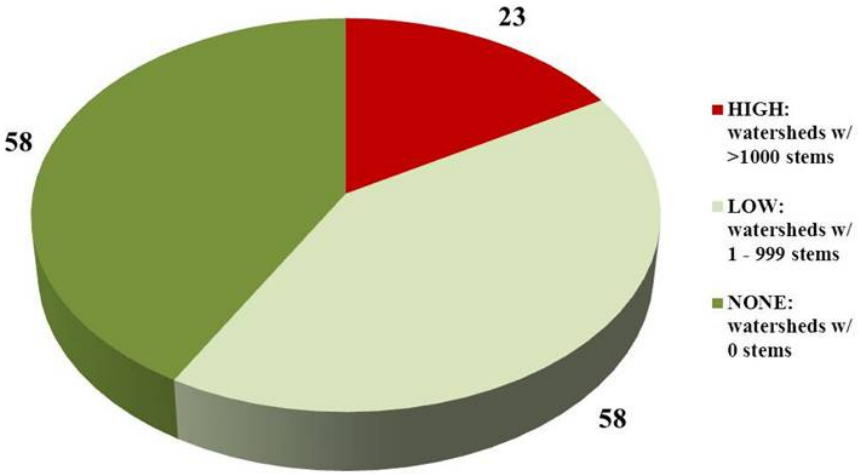
Huc-12 Subwatershed	Trend
No subwatersheds within Reporting Area had high intensity of MPB in 2012	

Clearwater Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

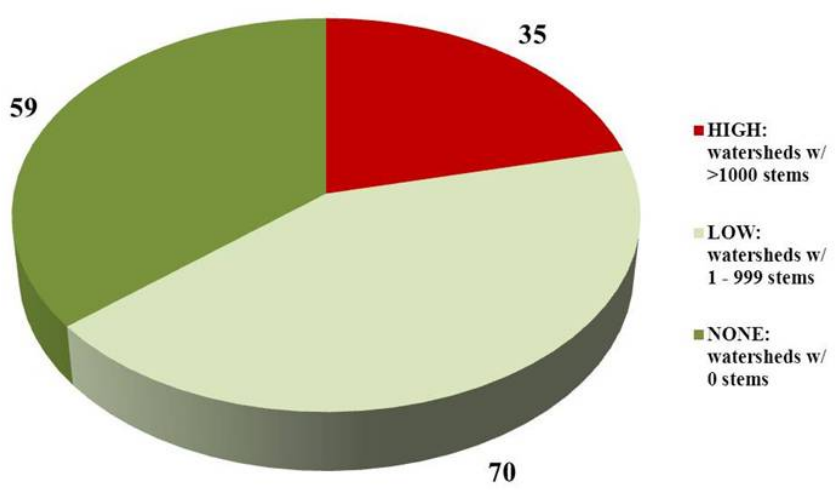
2011

84% subwatershed coverage within reporting area

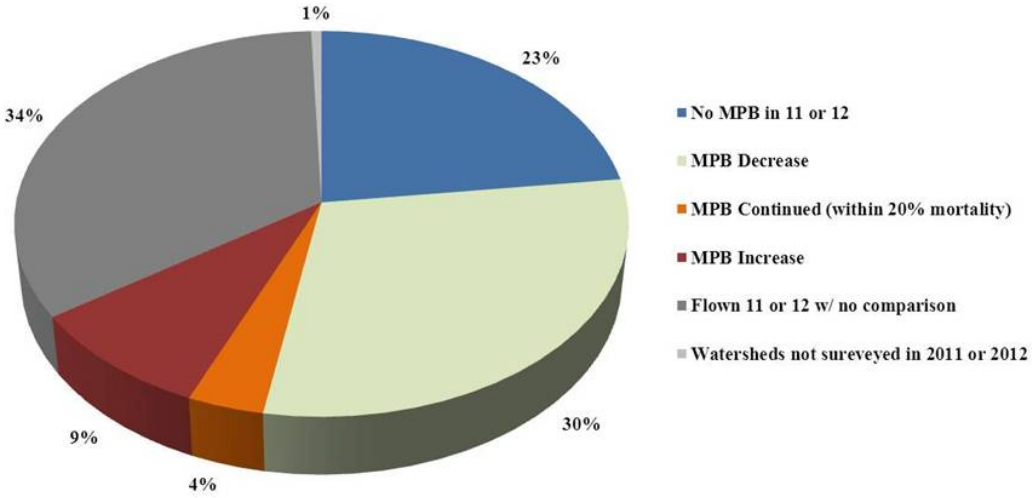


2012

99% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
French Creek	Increasing
Lower Fish Creek	Increasing
Middle Weitas Creek	Increasing
Boulder Creek-Crooked Fork Creek	Decreasing
Hungery Creek	Decreasing
Little Weitas Creek	Decreasing
Middle Creek	Decreasing
Post Office Creek	Decreasing
Upper Crooked Fork Creek	Decreasing
Upper Lolo Creek	Decreasing
Upper Weitas Creek	Decreasing
Wendover Creek-Lochsa River	Decreasing

Additional subwatersheds on next page

Clearwater Reporting Area

MPB trend in 2012 relative to 2011 within Huc-12 subwatersheds that had High MPB intensity detected in 2012

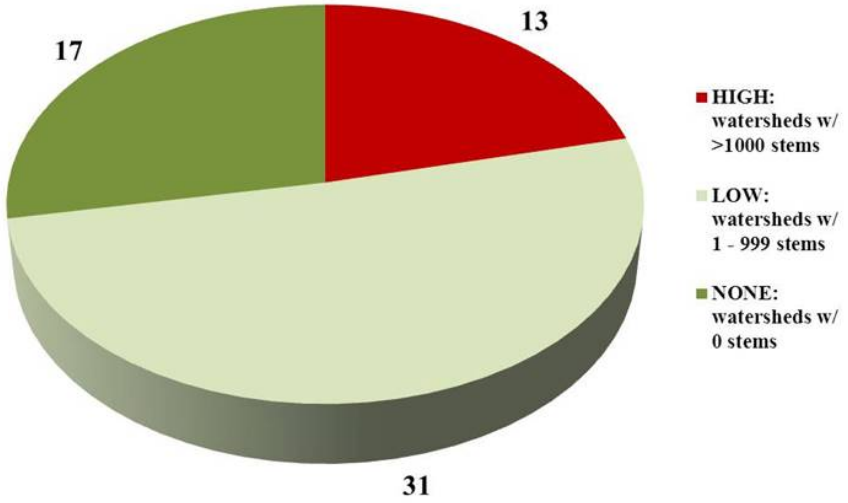
Subwatersheds with High Intensity MPB in 2012
w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Colt Creek	Unknown
Lower Big Sand Creek	Unknown
Lower Brushy Fork Creek	Unknown
Lower Cayuse Creek	Unknown
Spruce Creek	Unknown
Storm Creek	Unknown
Toboggan Creek	Unknown
Upper Kelly Creek	Unknown
Vanderbilt Creek-North Fork Clearwater River	Unknown
Fourth of July Creek	Unknown
Gravey Creek	Unknown
Johnny Creek	Unknown
Kelly Fork Creeks	Unknown
Lower Colt Killed Creek	Unknown
Lower Kelly Creek	Unknown
Lower Warm Springs Creek	Unknown
Middle Cayuse Creek	Unknown
Monroe Creek	Unknown
Upper Cayuse Creek	Unknown
Walton Creek-Lochsa River	Unknown

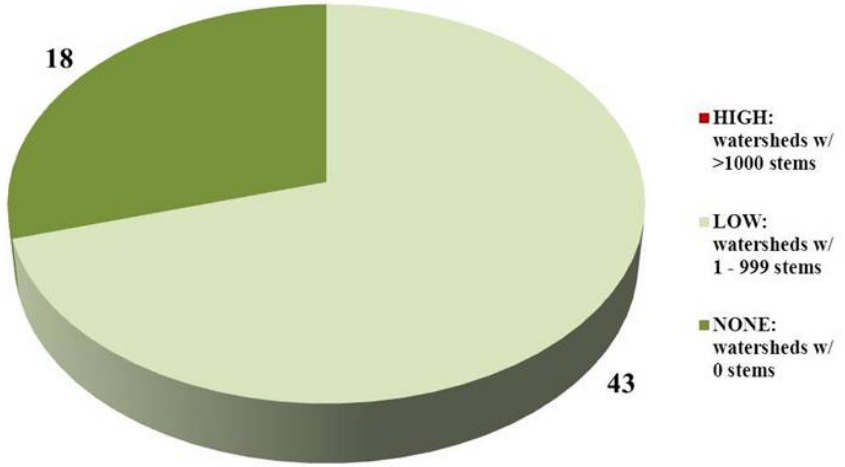
Coeur d'Alene Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

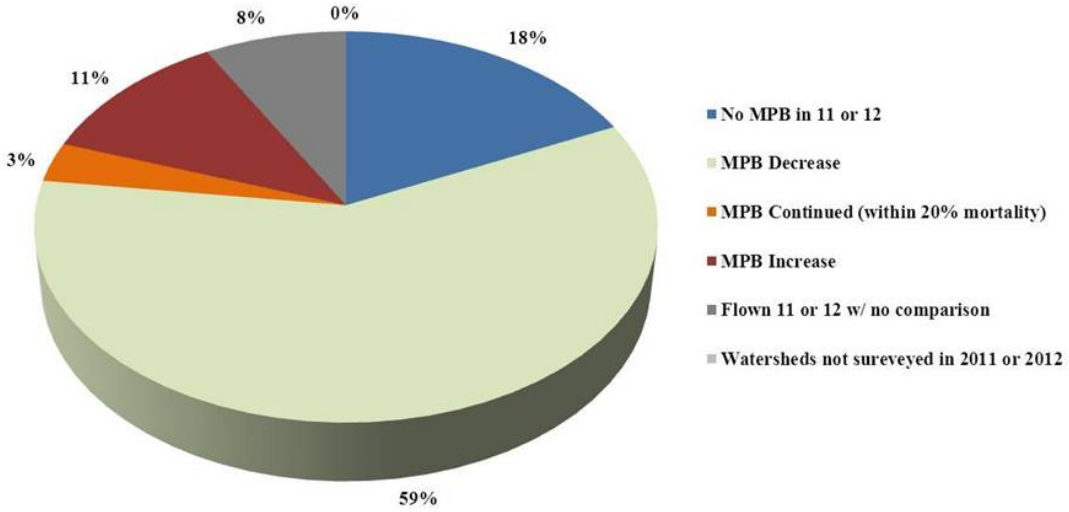
2011
100% subwatershed coverage within reporting area



2012
100% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend

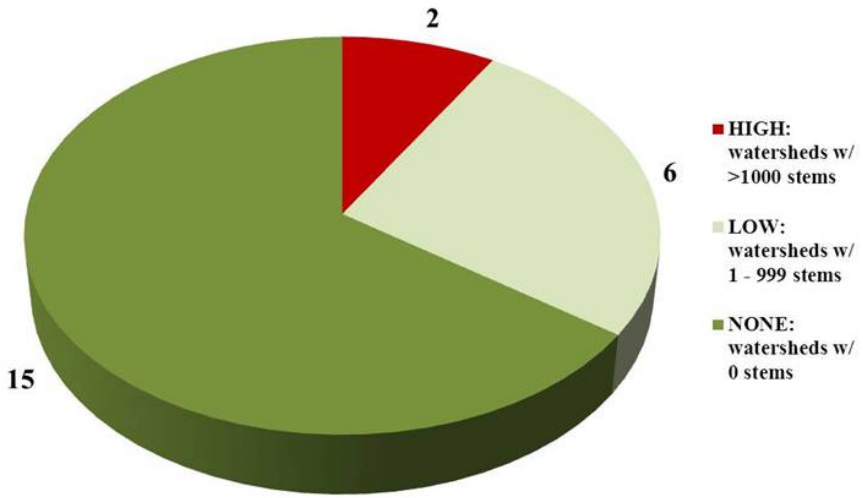
No subwatersheds within Reporting Area had high intensity of MPB in 2012

Coeur d'Alene Indian Reservation Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

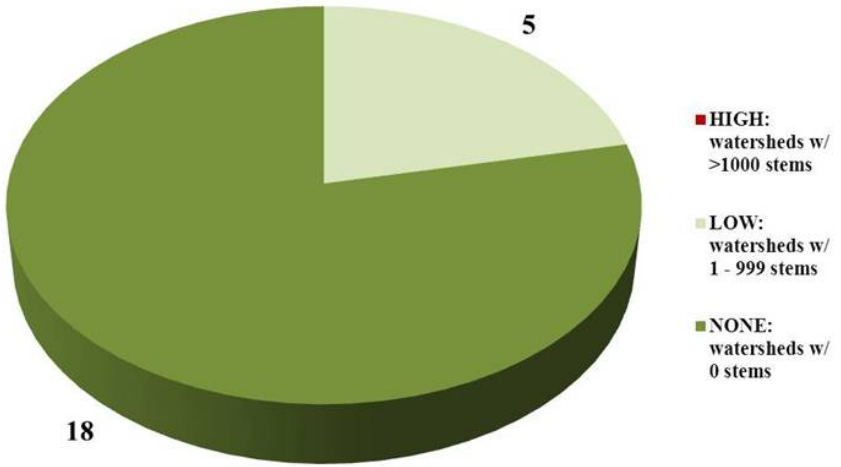
2011

100% subwatershed coverage within reporting area

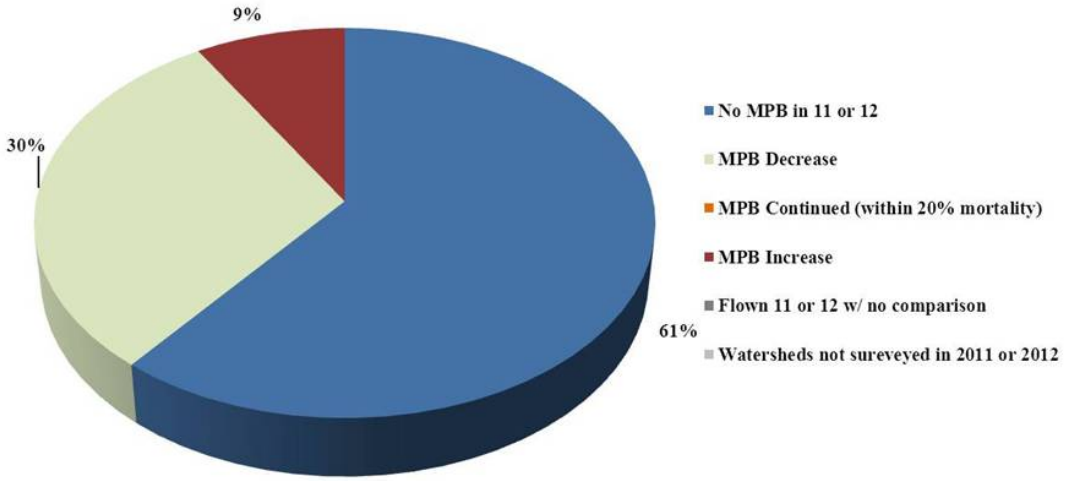


2012

100% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

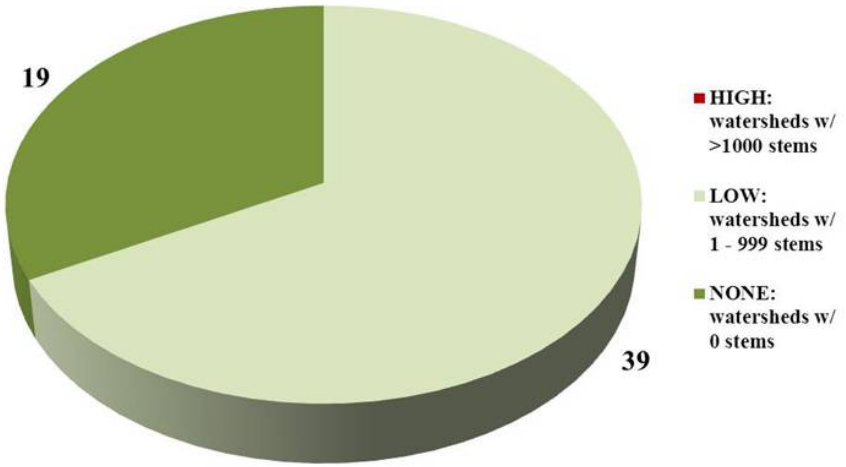
Huc-12 Subwatershed	Trend
No subwatersheds within Reporting Area had high intensity of MPB in 2012	

Crow Indian Reservation Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

2011

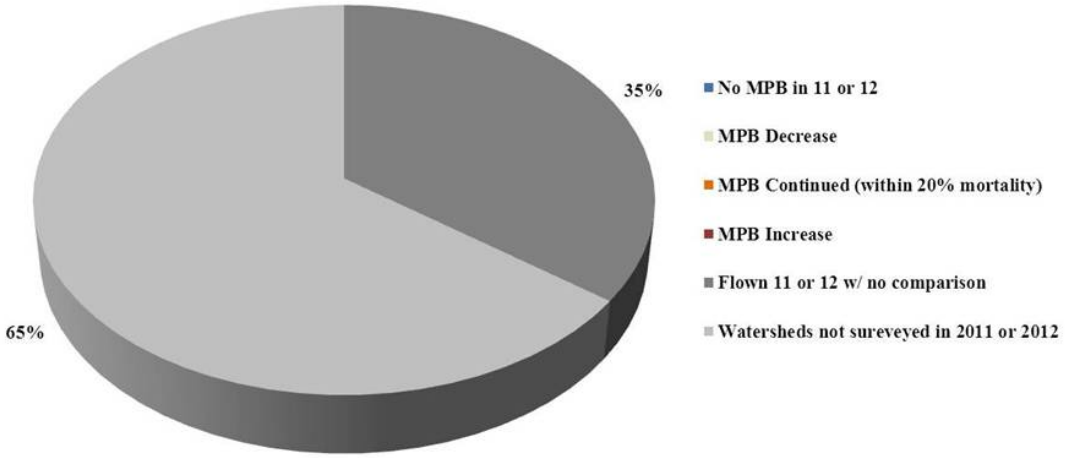
35% subwatershed coverage within reporting area



2012

0% subwatershed coverage within reporting area

Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

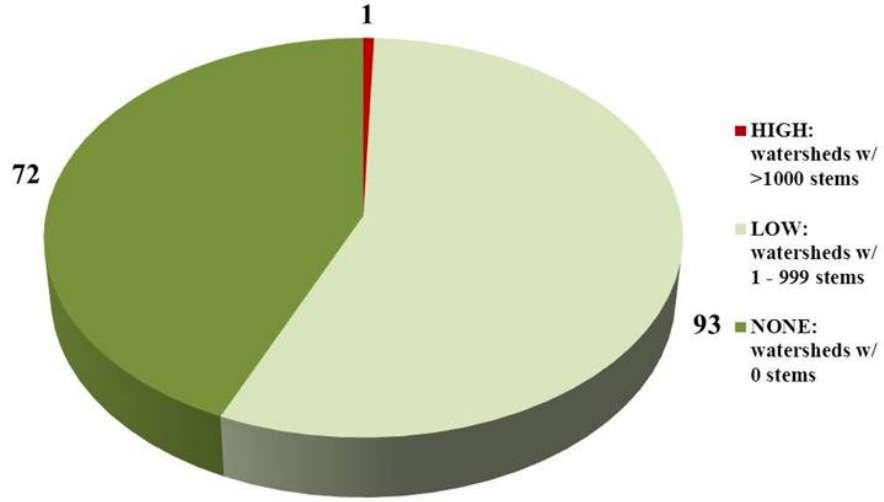
Huc-12 Subwatershed	Trend
No subwatersheds within Reporting Area had high intensity of MPB in 2012	

Custer Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

2011

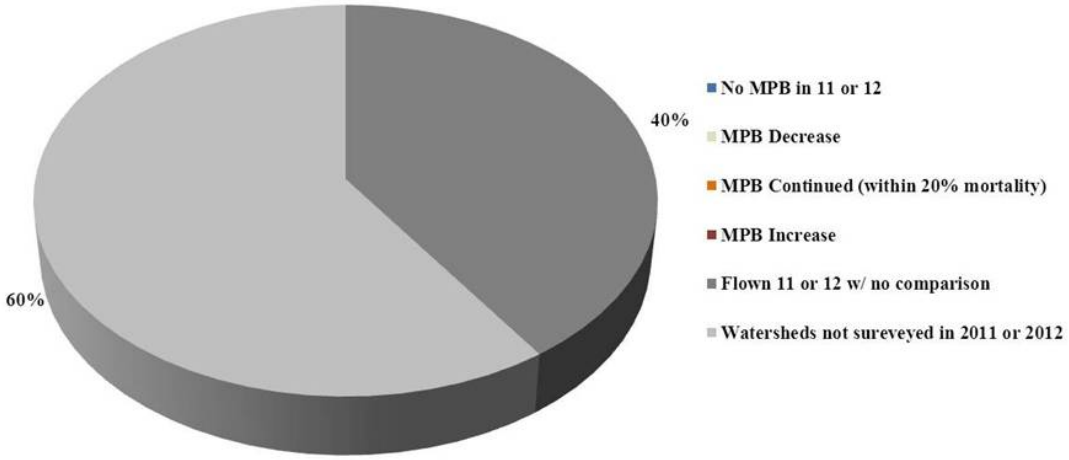
40% subwatershed coverage within reporting area



2012

0% subwatershed coverage within reporting area

Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

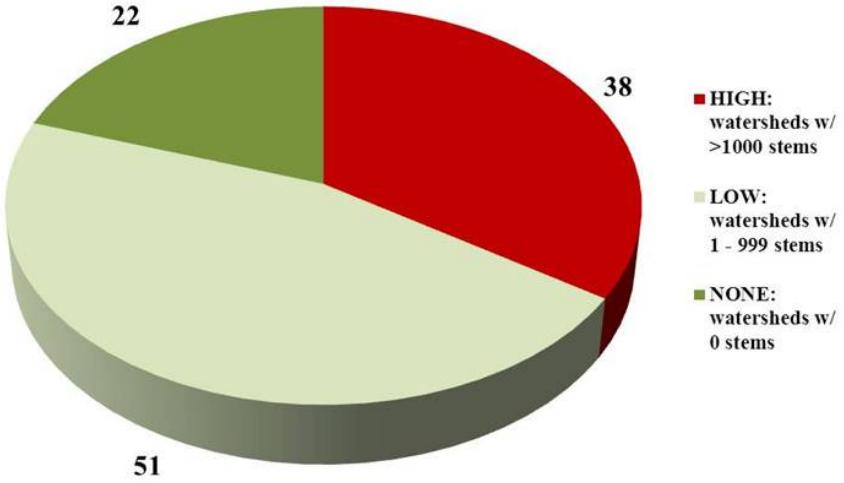
Huc-12 Subwatershed	Trend
No subwatersheds within Reporting Area had high intensity of MPB in 2012	

Deerlodge Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

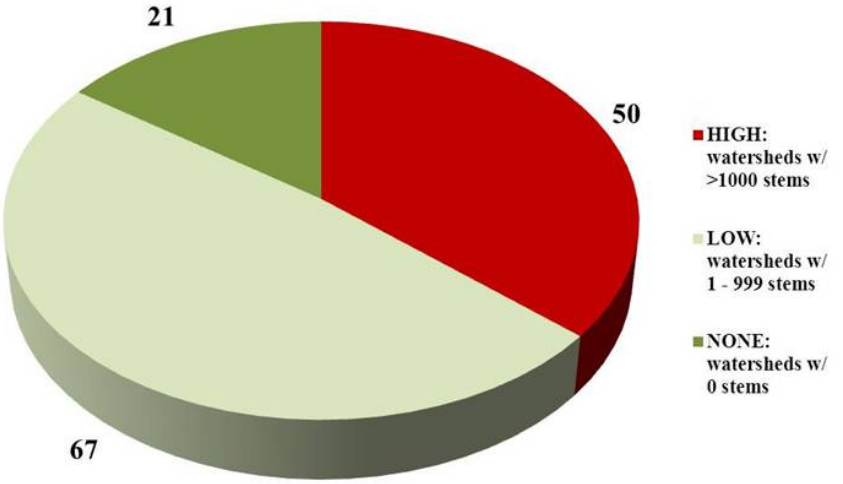
2011

73% subwatershed coverage within reporting area

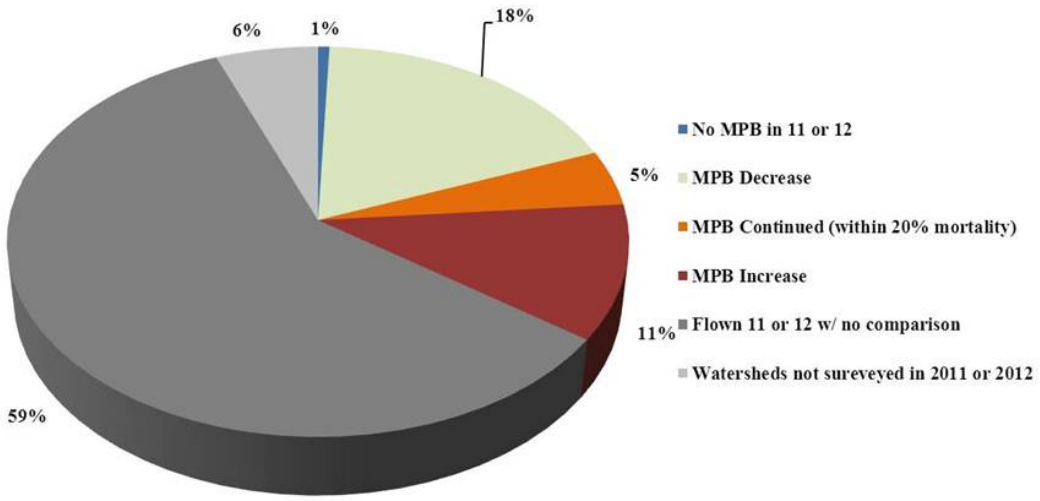


2012

91% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Cottonwood Creek	Increasing
Elkhorn Creek	Increasing
Lower South Fork Lower Middle Creek	Increasing
Middle Upper Willow Creek	Increasing
Rock Creek-Flat Gulch	Increasing
Rock Creek-Mallard Creek	Increasing
Stoney Creek	Increasing
Basin Creek	Decreasing
Douglas Creek	Decreasing
Gold Creek	Decreasing

Additional subwatersheds on next page

Deerlodge Reporting Area

MPB trend in 2012 relative to 2011 within Huc-12 subwatersheds that had High MPB intensity detected in 2012

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Harvey Creek	Decreasing
Lower Upper Willow Creek	Decreasing
Marshall Creek	Decreasing
Meadow Creek	Decreasing
North Fork Lower Middle Willow Creek	Decreasing
Rock Creek-Boulder River	Decreasing
Silver Lake	Decreasing
Smart Creek	Decreasing
Trout Creek	Decreasing
Upper South Fork Lower Middle Creek	Decreasing
Upper Upper Willow Creek	Decreasing
Dampsey Creek	Unknown
Foster Creek	Unknown
Fred Burr Creek	Unknown
German Gulch	Unknown
Lower Ross Fork Rock Creek	Unknown
Middle Middle Fork Rock Creek	Unknown
Racetrack Creek	Unknown

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

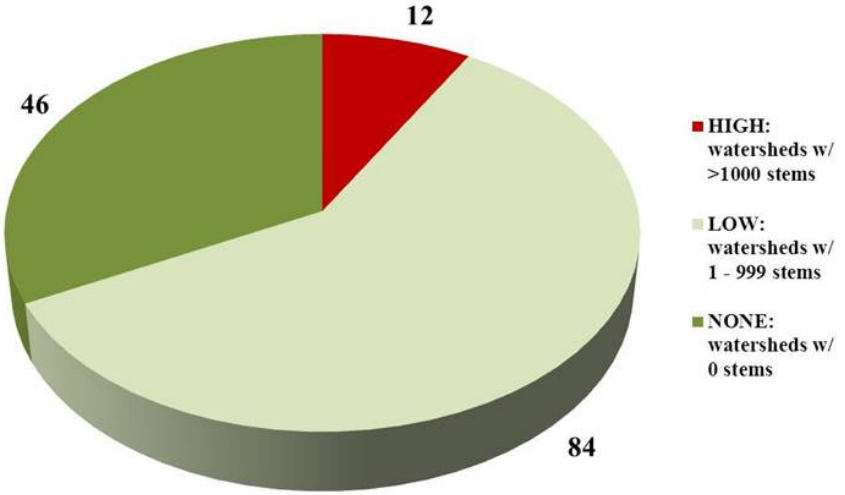
Huc-12 Subwatershed	Trend
South Boulder Creek	Unknown
Upper Boulder Creek	Unknown
Willow Creek	Unknown
Carpp Creek	Unknown
Cooper Creek	Unknown
East Fork Reservoir	Unknown
East Fork Rock Creek	Unknown
Flint Creek	Unknown
Flint Creek-Philipsburg	Unknown
Headwaters Warm Springs Creek	Unknown
Lower Boulder Creek	Unknown
Lower Middle Fork Rock Creek	Unknown
Lower West Fork Ross Creek	Unknown
Middle Ross Fork Rock Creek	Unknown
Mill Creek	Unknown
North Fork Flint Creek	Unknown
Rock Creek	Unknown
Warm Springs Creek-West Valley	Unknown
Williams Gulch-Rock Creek	Unknown

Flathead Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

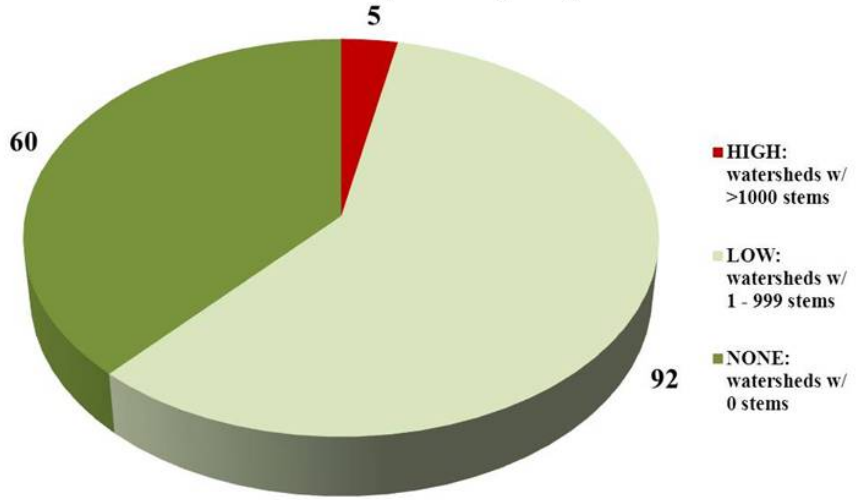
2011

81% subwatershed coverage within reporting area

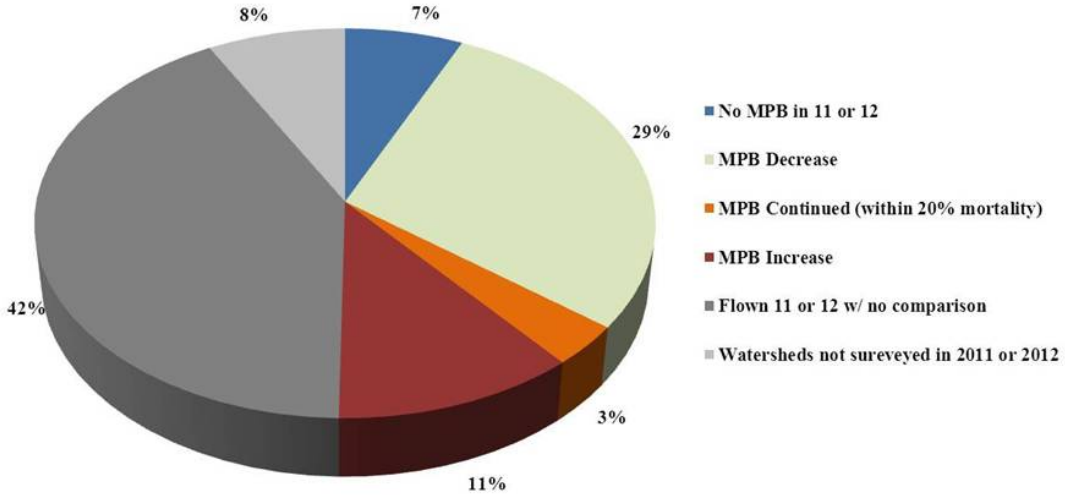


2012

90% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

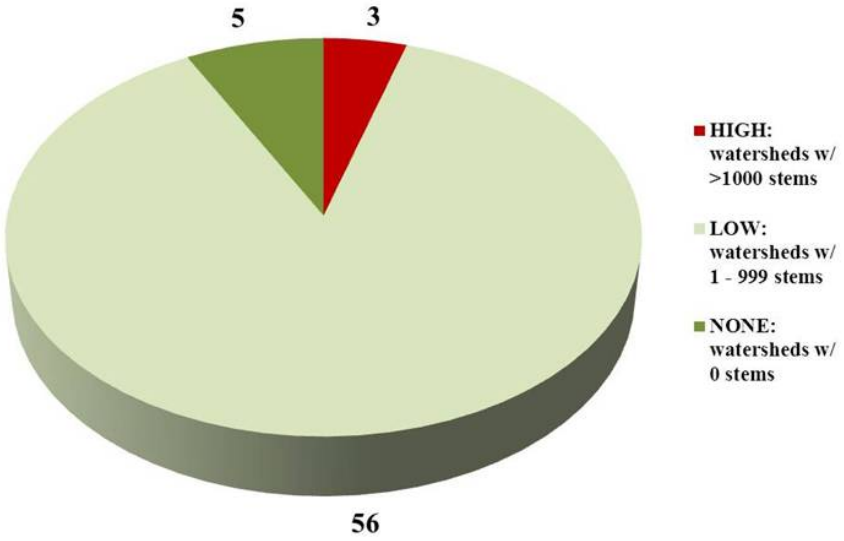
Huc-12 Subwatershed	Trend
Hay Creek	Increasing
Lion Creek	Decreasing
Middle Fork Flathead River-Tin Creek	Unknown
Quintonkon Creek	Unknown
Middle Fork Flathead River-Bear Creek	Unknown

Flathead Indian Reservation Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

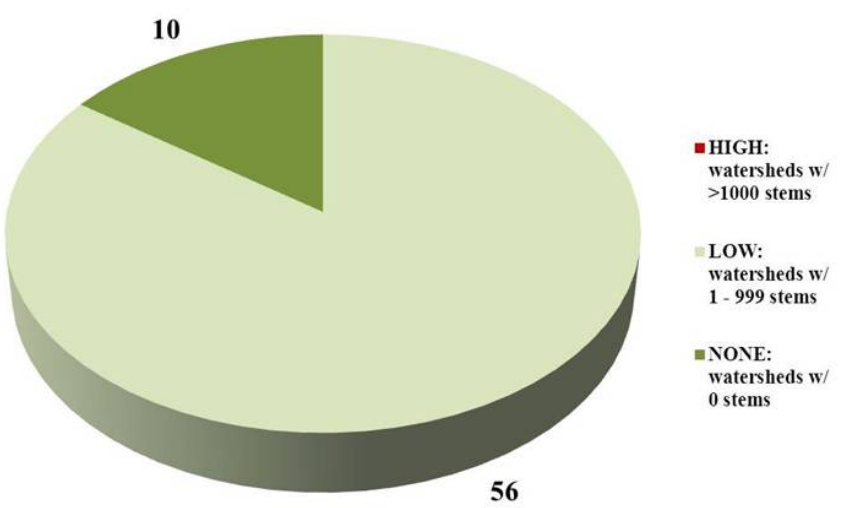
2011

97% subwatershed coverage within reporting area

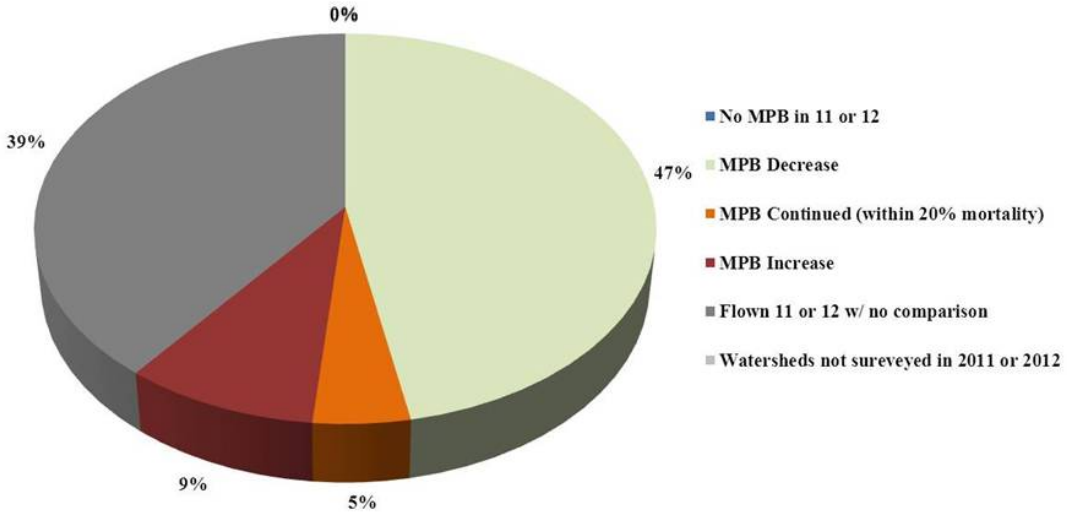


2012

100% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



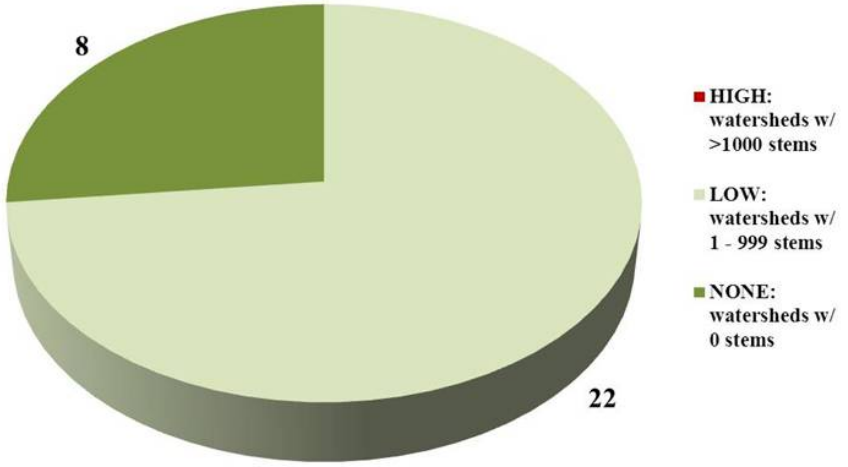
Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
No subwatersheds within Reporting Area had high intensity of MPB in 2012	

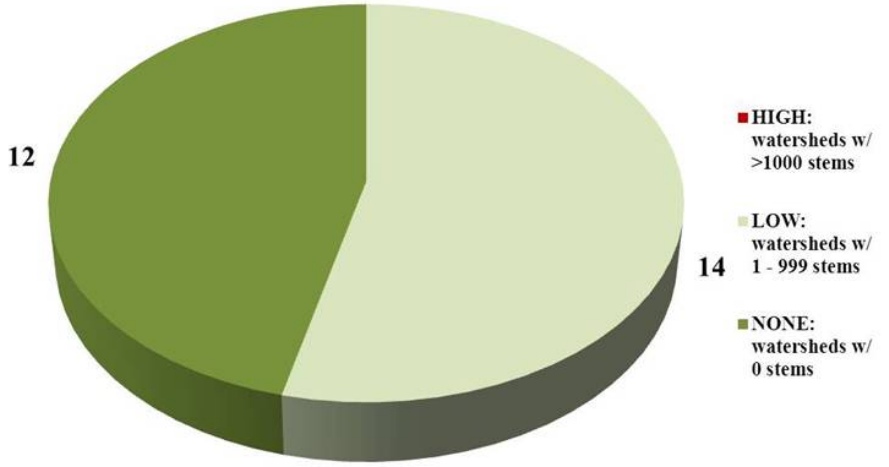
Fort Belknap IR Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

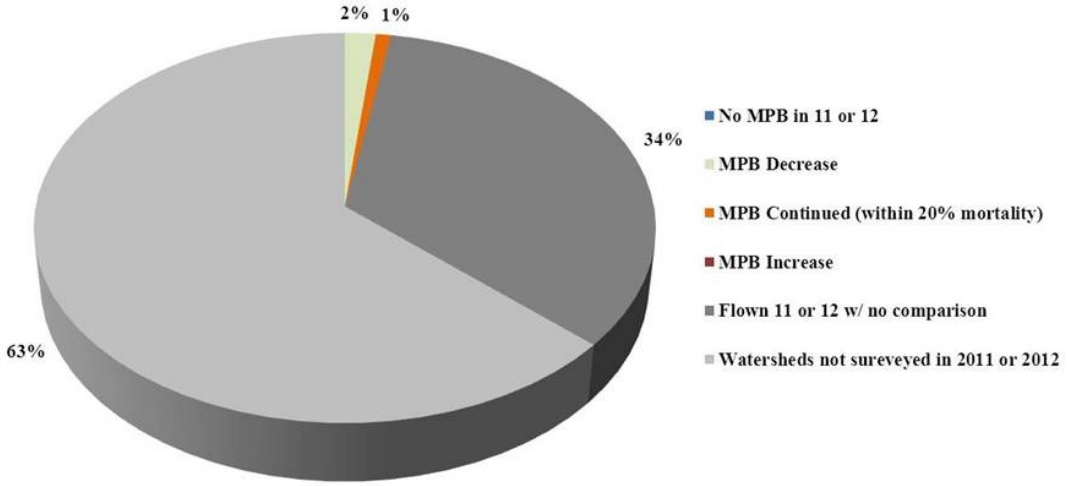
2011
27% subwatershed coverage within reporting area



2012
23% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



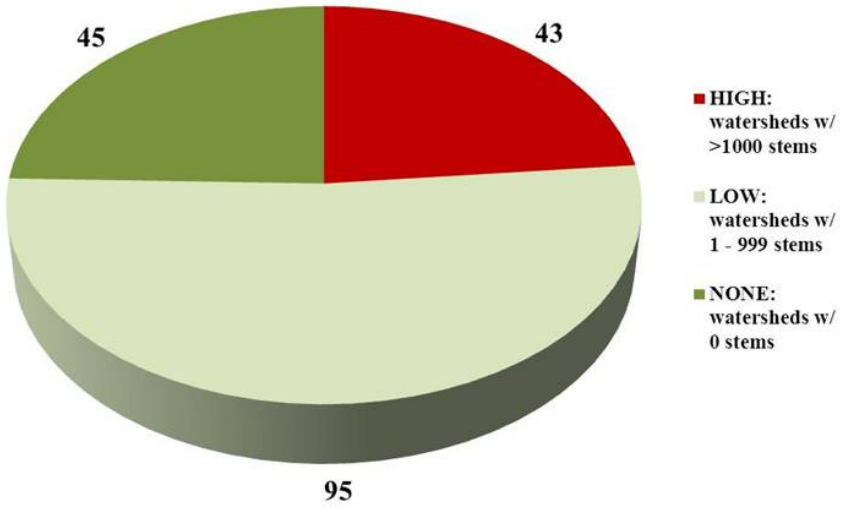
Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
No subwatersheds within Reporting Area had high intensity of MPB in 2012	

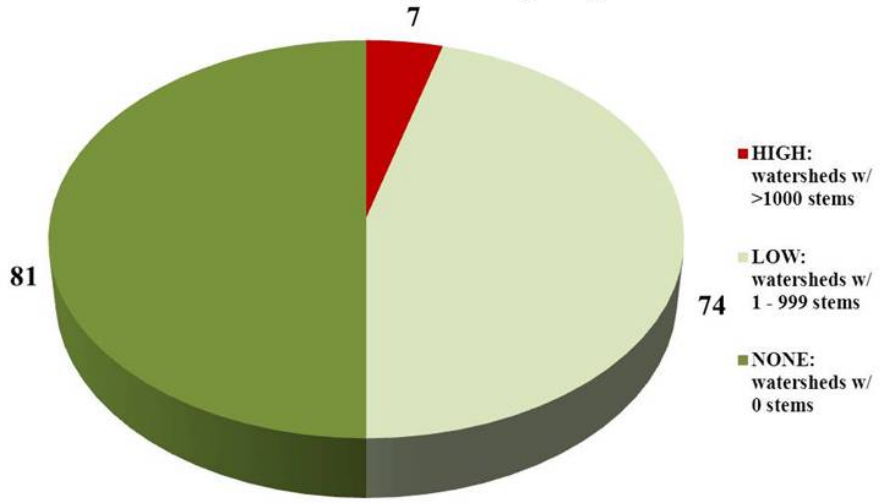
Gallatin Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

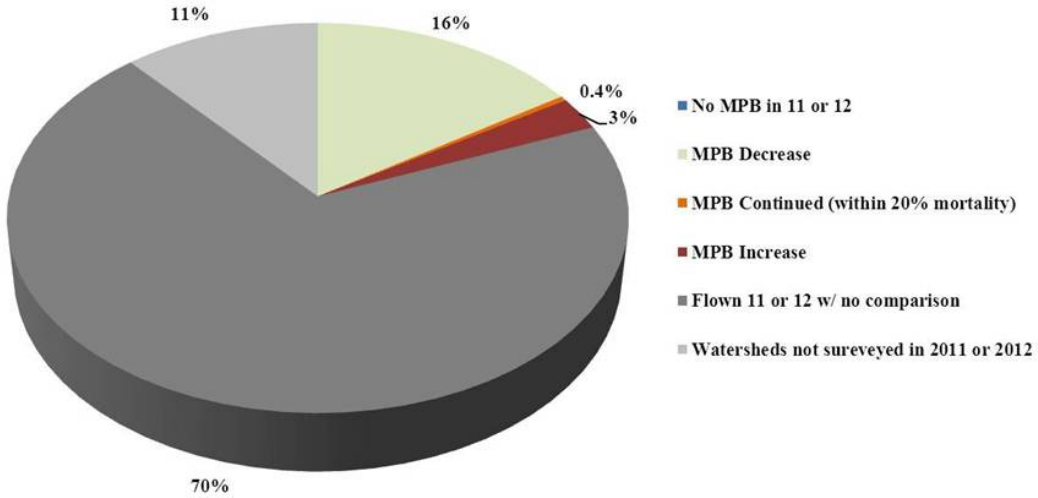
2011
72% subwatershed coverage within reporting area



2012
64% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

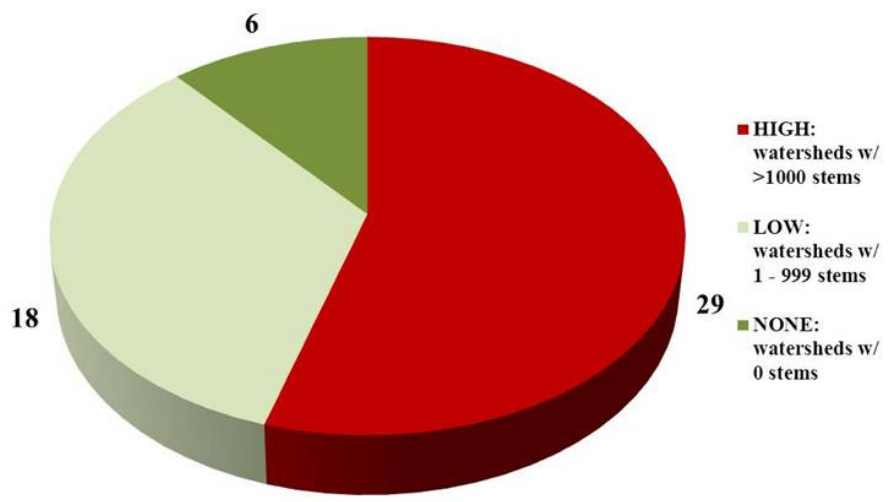
Huc-12 Subwatershed	Trend
Bangtail Creek	Increasing
Porcupine Creek	Decreasing
Portal Creek	Decreasing
Rock Creek	Decreasing
South Fork West Fork Gallatin River	Decreasing
Upper Big Creek	Decreasing
Smith Creek	Unknown

Garnet Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

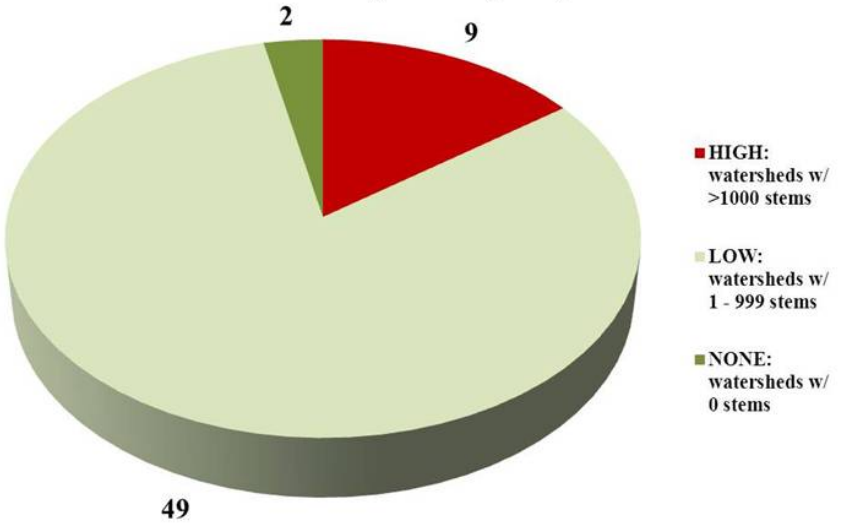
2011

88% subwatershed coverage within reporting area

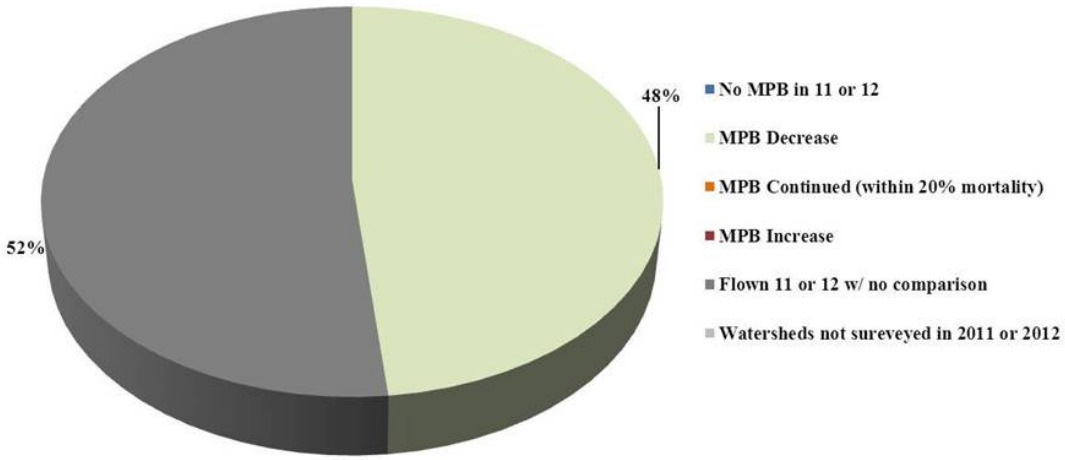


2012

100% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds

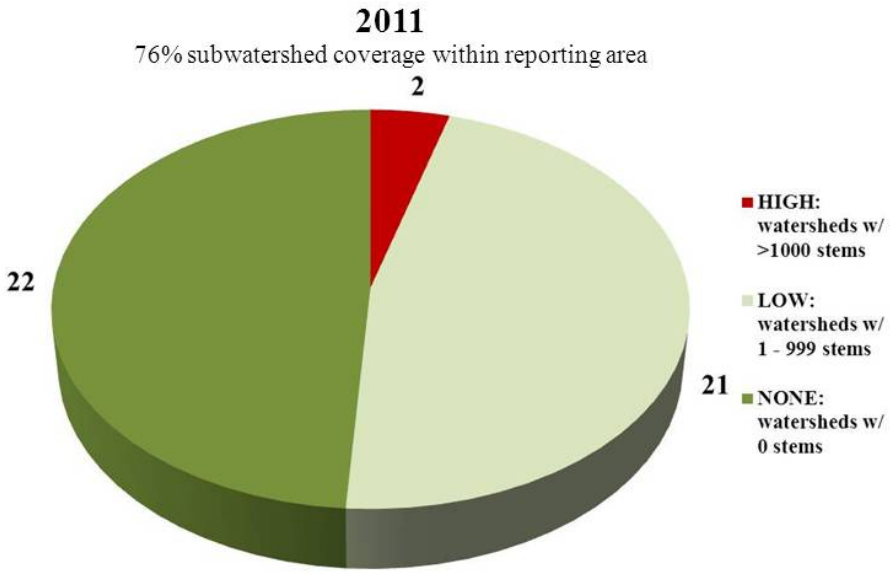


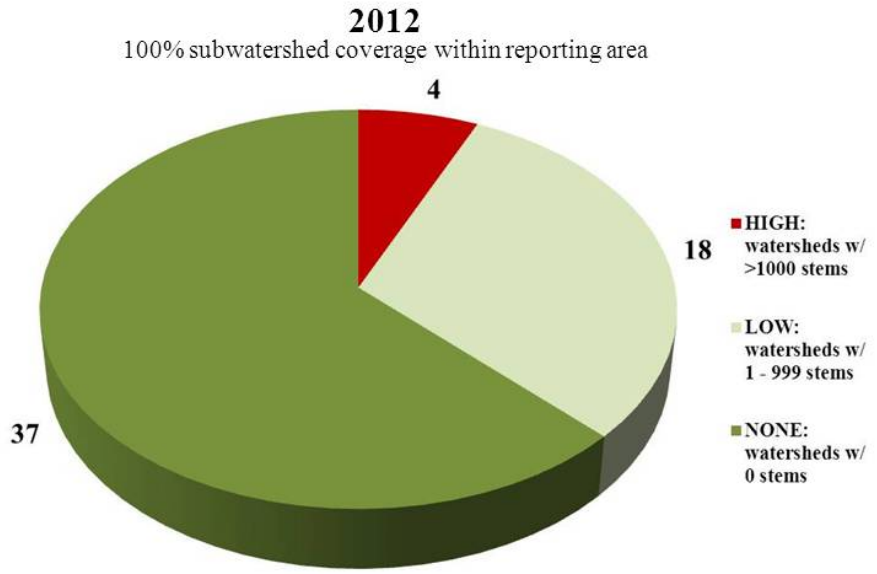
Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Blackfoot River-Lahrity Lake	Decreasing
Cottonwood Creek	Decreasing
Lower Union Creek	Decreasing
Upper Elk Creek	Decreasing
Wales Creek	Decreasing
Yourname Creek	Decreasing
Warm Springs Creek	Unknown
Clark Fork River-Wallace Creek	Unknown
Middle Nevada Creek	Unknown

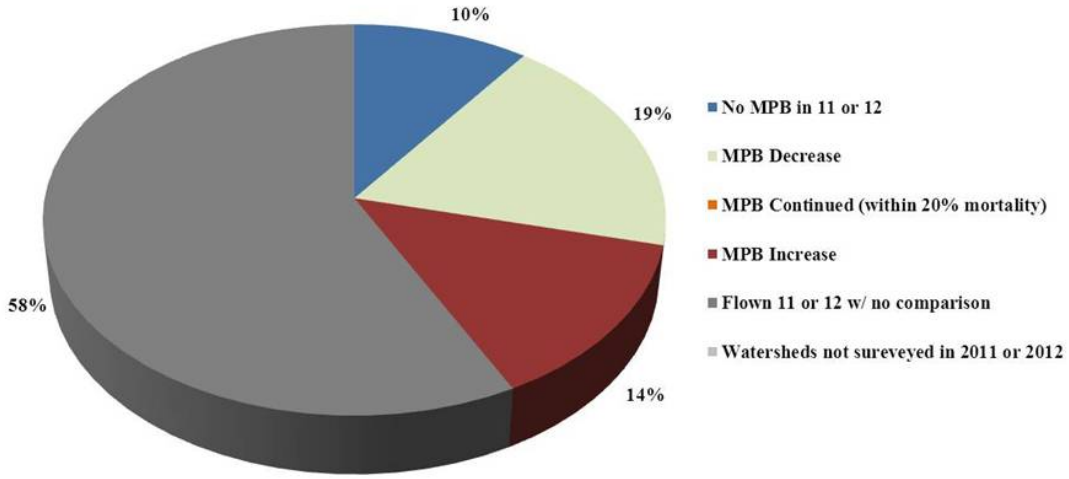
Glacier National Park Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012





Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



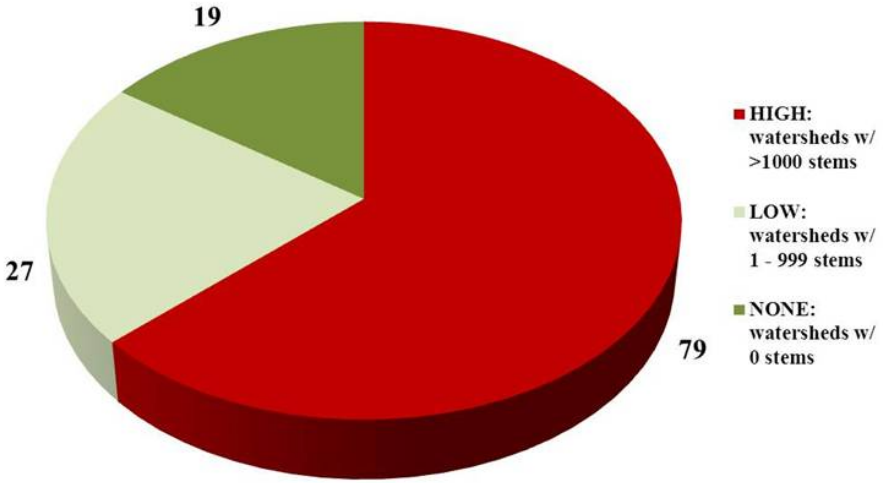
Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Lincoln Creek	Increasing
Middle Fork Flathead River-Coal Creek	Increasing
Ole Creek	Increasing
Middle Fork Flathead River-Bear Creek	Unknown

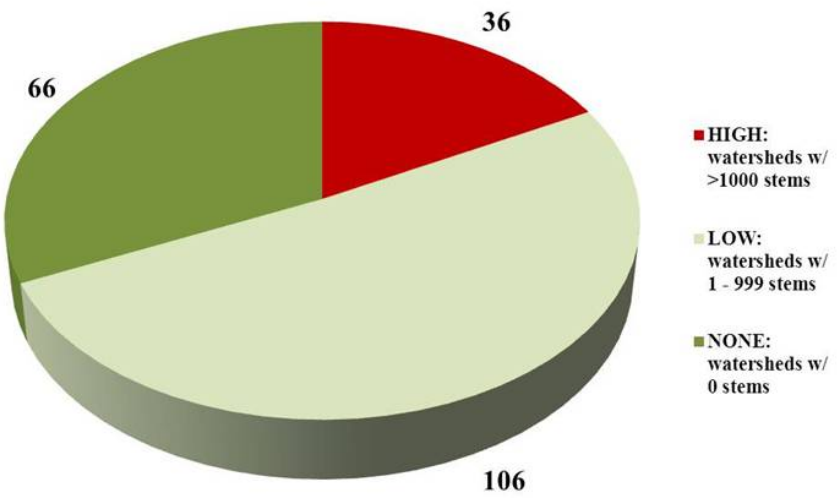
Helena Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

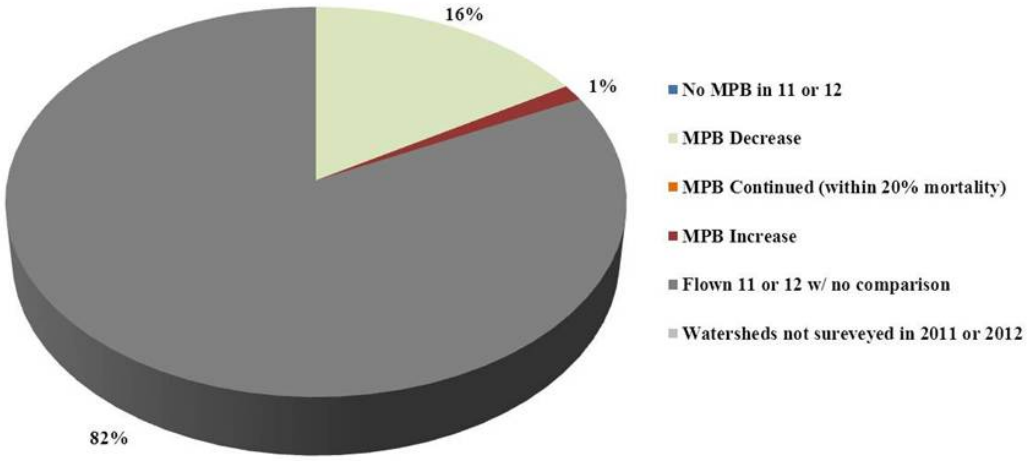
2011
55% subwatershed coverage within reporting area



2012
92% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Cottonwood Creek	Increasing
Basin Creek	Decreasing
Last Chance Gulch	Decreasing
Lower Tenmile Creek	Decreasing
McClellan Creek	Decreasing
Upper Beaver Creek	Decreasing

Additional subwatersheds on next page

Helena Reporting Area

MPB trend in 2012 relative to 2011 within Huc-12 subwatersheds that had High MPB intensity detected in 2012

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

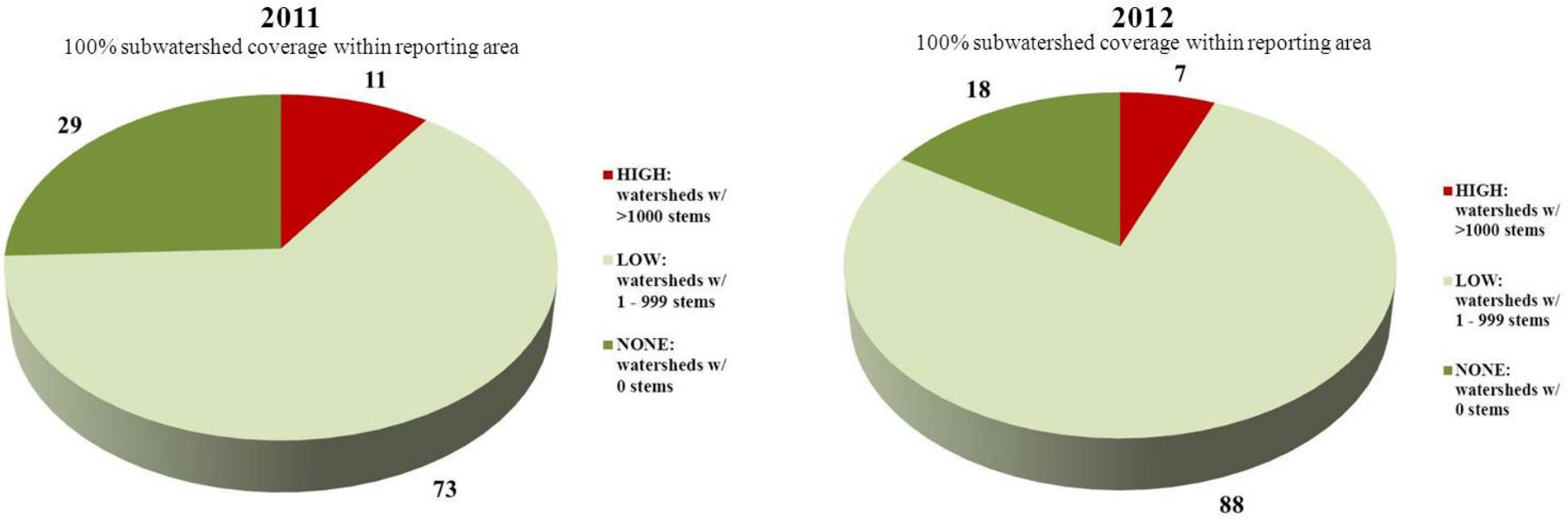
Huc-12 Subwatershed	Trend
Avalanche Creek	Unknown
Beaver Creek	Unknown
Big Birch Creek	Unknown
Black Canyon	Unknown
Blacktail Creek-Smith River	Unknown
Cottonwood Creek	Unknown
Cottonwood Creek-Smith River	Unknown
Cottonwood Gulch	Unknown
Duck Creek	Unknown
Ellis Canyon	Unknown
Gurnett Creek	Unknown
Little Birch Creek	Unknown
Lower Rock Creek	Unknown
Lower Trout Creek	Unknown
Middle Creek	Unknown

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

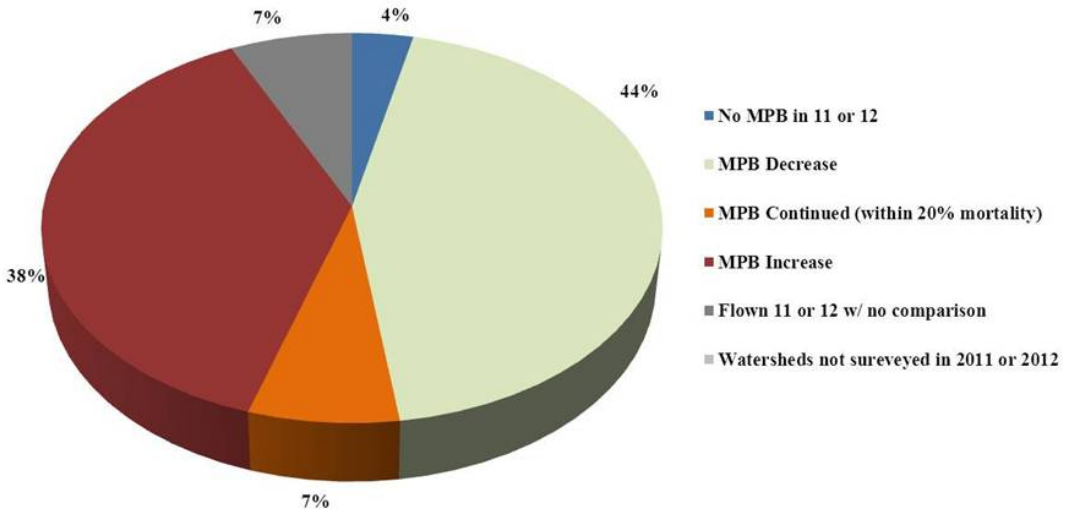
Huc-12 Subwatershed	Trend
Oregon Gulch	Unknown
Ray Creek	Unknown
Sheep Creek	Unknown
Soup Creek	Unknown
Stickney Creek	Unknown
Upper Camas Creek	Unknown
Upper Rock Creek	Unknown
Wegner Creek	Unknown
West Fork Hound Creek	Unknown
Beartooth Mountain-Missouri River	Unknown
Headwaters Crow Creek	Unknown
Middle Nevada Creek	Unknown
Missouri River-Hauser Lake	Unknown
Whitehorse Creek-Canyon Ferry Lake	Unknown

Kaniksu Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

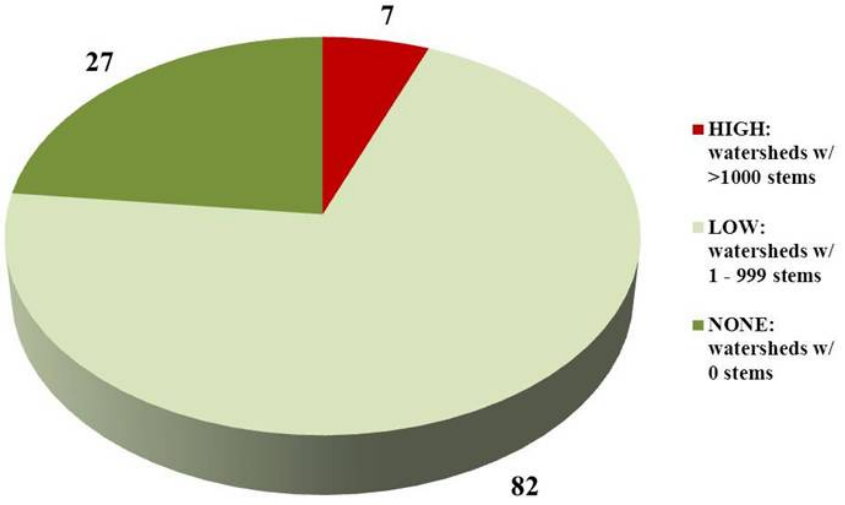
Huc-12 Subwatershed	Trend
North Fork Granite Creek	Increasing
Brush Creek-Kootenai River	Decreasing
Grass Creek	Decreasing
Hall Creek-Kootenai River	Decreasing
Long Canyon Creek	Decreasing
Lower Smith Creek	Decreasing
Saddle Creek-Boundary Creek	Unknown

Kootenai Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

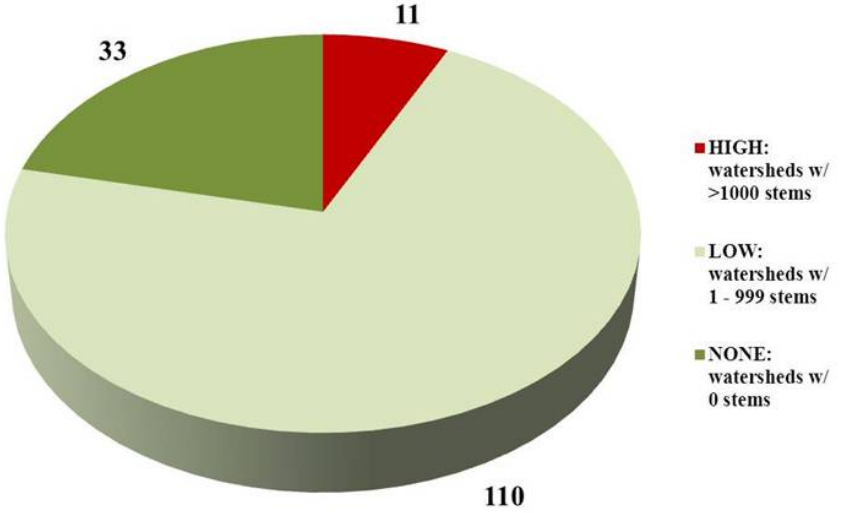
2011

75% subwatershed coverage within reporting area

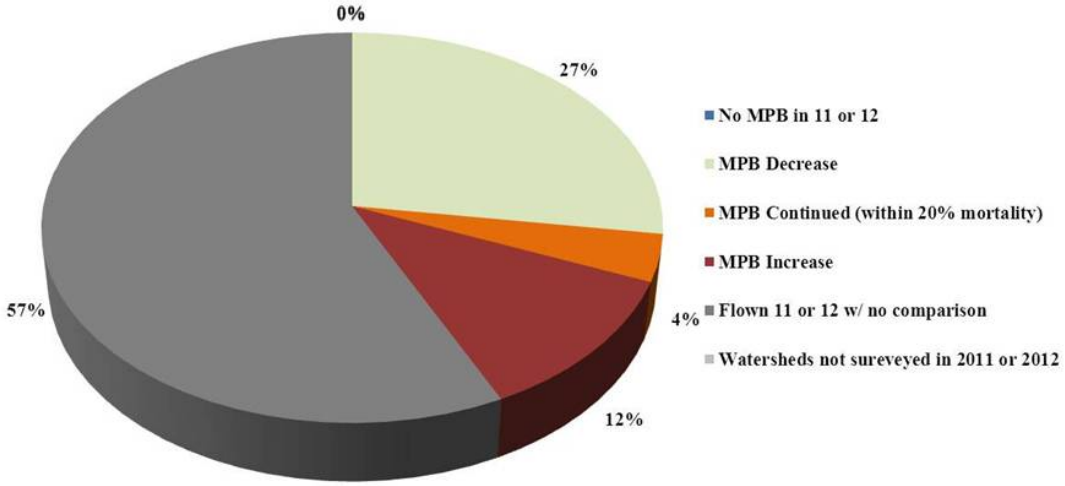


2012

100% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

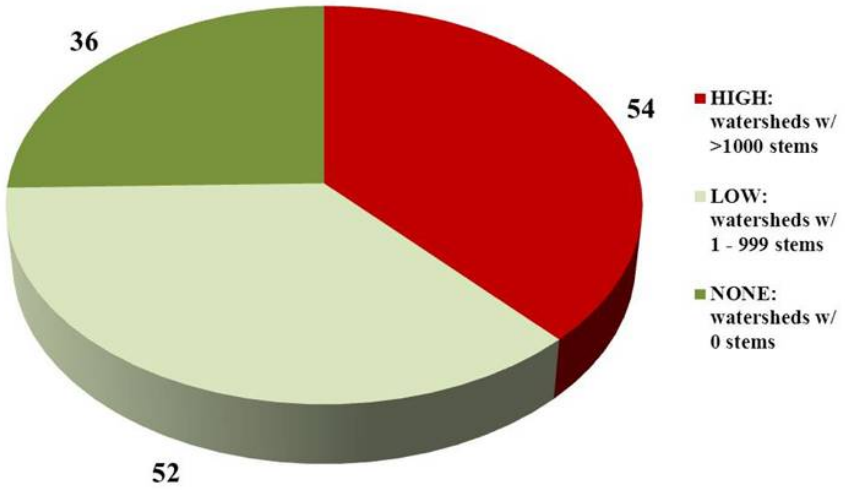
Huc-12 Subwatershed	Trend
Pilgrim Creek	Increasing
East Fisher Creek	Decreasing
Lower Vermilion River	Decreasing
Marten Creek	Decreasing
Middle Vermilion River	Decreasing
Lower Bull River	Unknown
Noxon Reservoir-Belgian Gulch	Unknown
Noxon Reservoir-Stevens Creek	Unknown
Silver Butte Fisher River	Unknown
Swamp Creek	Unknown
Upper Trout Creek	Unknown

Lewis and Clark Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

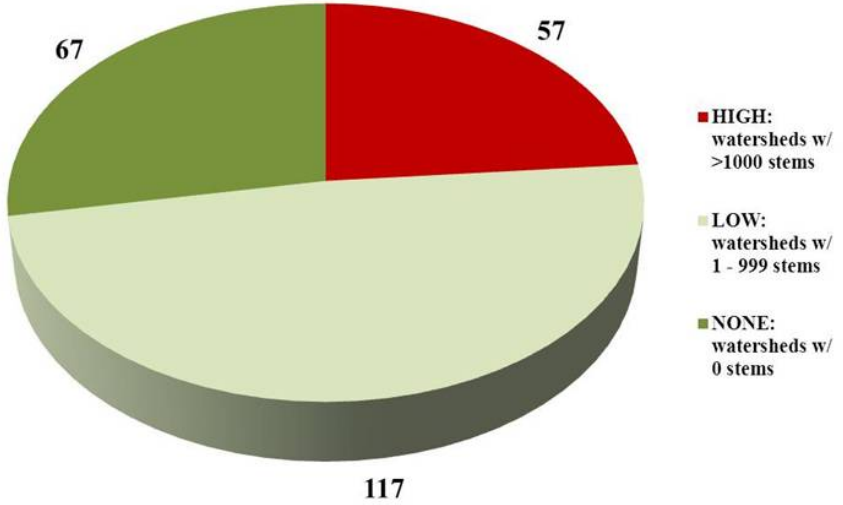
2011

35% subwatershed coverage within reporting area

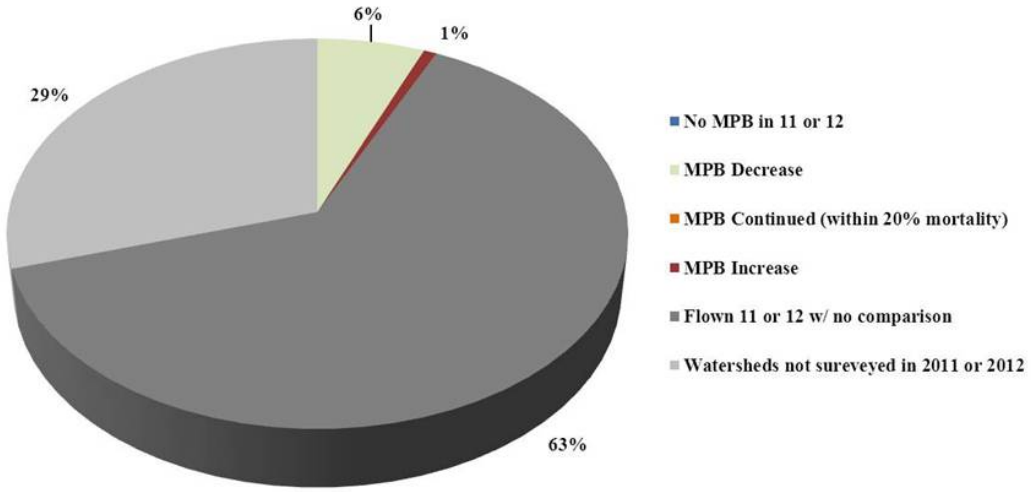


2012

60% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Cleveland Creek	Decreasing
Iron Creek-Belt Creek	Decreasing
Logging Creek	Decreasing
Lone Tree Creek	Decreasing
Middle Fork Judith River	Decreasing
Nasen Coulee-Belt Creek	Decreasing
Pilgrim Creek	Decreasing
Upper Antelope Creek	Decreasing
Upper Roberts Creek	Decreasing
Upper South Fork Judith River	Decreasing
Yogo Creek	Decreasing

Lewis and Clark Reporting Area

MPB trend in 2012 relative to 2011 within Huc-12 subwatersheds that had High MPB intensity detected in 2012

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Alabaugh Creek	Unknown
Big Rock Creek	Unknown
Blacktail Creek-Smith River	Unknown
Boyd Creek	Unknown
Buffalo Creek-Ross Fork Creek	Unknown
Checkerboard Creek	Unknown
Cottonwood Creek	Unknown
Cottonwood Creek-Smith River	Unknown
Dry Fork Musselshell River	Unknown
Flagstaff Creek	Unknown
Fourmile Creek	Unknown
Headwaters Arrow Creek	Unknown
Headwaters Careless Creek	Unknown
Headwaters Highwood Creek	Unknown
Headwaters Willow Creek	Unknown
Lake Sutherlin-North Fork Smith River	Unknown
Little Belt Creek	Unknown
Lower Tenderfoot Creek	Unknown
Middle North Fork Mussellshell River	Unknown
Middle Sheep Creek	Unknown
Middle Warm Spring Creek	Unknown
Minerva Creek	Unknown

Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

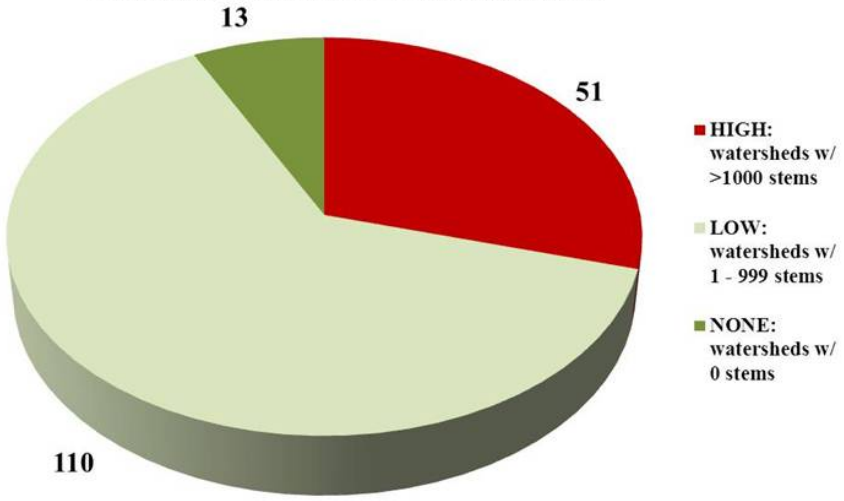
Huc-12 Subwatershed	Trend
Outlet Big Spring Creek	Unknown
Sheep Creek	Unknown
South Fork Flatwillow Creek	Unknown
Spring Creek	Unknown
Upper Cameron Creek	Unknown
Upper Eagle Creek	Unknown
Upper Highwood Creek	Unknown
Upper Merrills Springs Creek	Unknown
Upper Newlan Creek	Unknown
Upper Pole Creek	Unknown
Upper Shonkin Creek	Unknown
Upper Swimming Woman Creek	Unknown
Upper Twin Coulee	Unknown
Walters Coulee	Unknown
Daisy Dean Creek	Unknown
East Fork Haymaker Creek	Unknown
Headwaters Ross Fork Creek	Unknown
Moose Creek	Unknown
Spring Creek	Unknown
Trout Creek-North Fork Smith River	Unknown
Upper East Fork Roberts Creek	Unknown
Upper Hopley Creek	Unknown

Lolo Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

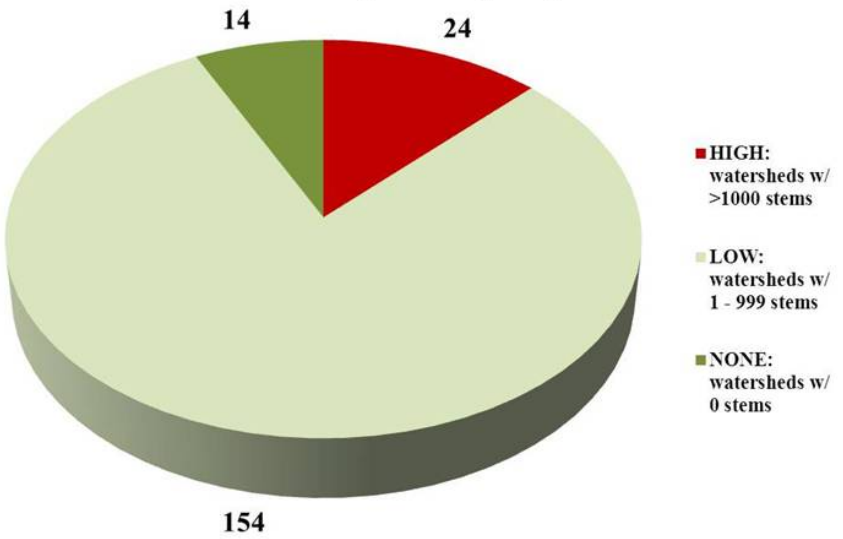
2011

90% subwatershed coverage within reporting area

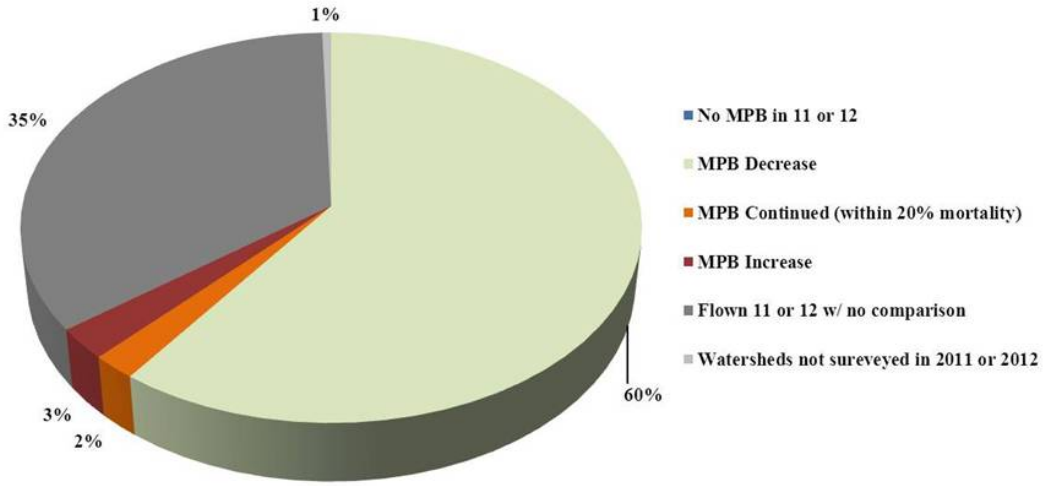


2012

99% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Upper Fishtrap Creek	Increasing
Cache Creek	Decreasing
Deer Creek	Decreasing
Harvey Creek	Decreasing
Lower Clearwater River	Decreasing
Trail Creek	Decreasing

Additional subwatersheds on next page

Lolo Reporting Area

MPB trend in 2012 relative to 2011 within Huc-12 subwatersheds that had High MPB intensity detected in 2012

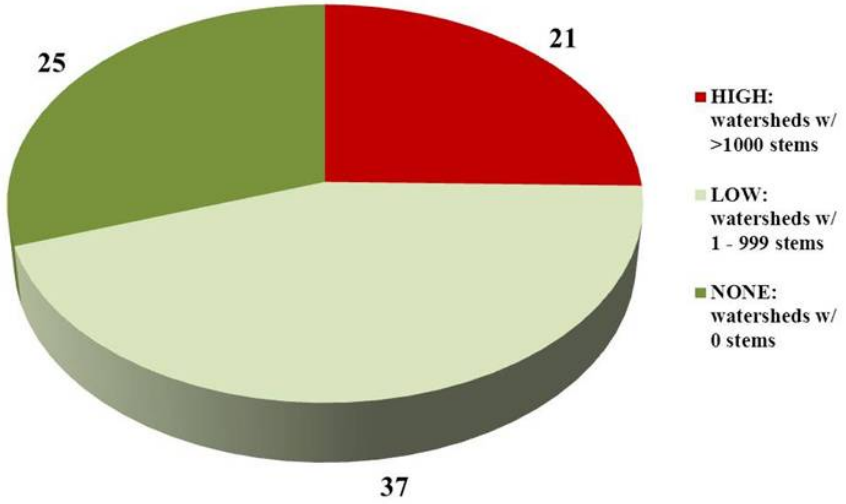
Subwatersheds with High Intensity MPB in 2012
w/ Trend Information where Available

Huc-12 Subwatershed	Trend
East Fork Lolo Creek	Unknown
O'Brien Creek	Unknown
Rock Creek-Cinnamon Bear Creek	Unknown
Rock Creek-Hutsinpilar Creek	Unknown
Schwartz Creek	Unknown
South Fork Lolo Creek	Unknown
Upper Lolo Creek	Unknown
West Fork Butte Creek	Unknown
Alder Creek	Unknown
Clark Fork River-Wallace Creek	Unknown
Granite Creek	Unknown
Hogback Creek	Unknown
Lolo Creek-Grave Creek	Unknown
Ranch Creek	Unknown
Rock Creek-Wahlquist Creek	Unknown
Tyler Creek	Unknown
West Fork Lolo Creek	Unknown
Williams Gulch-Rock Creek	Unknown

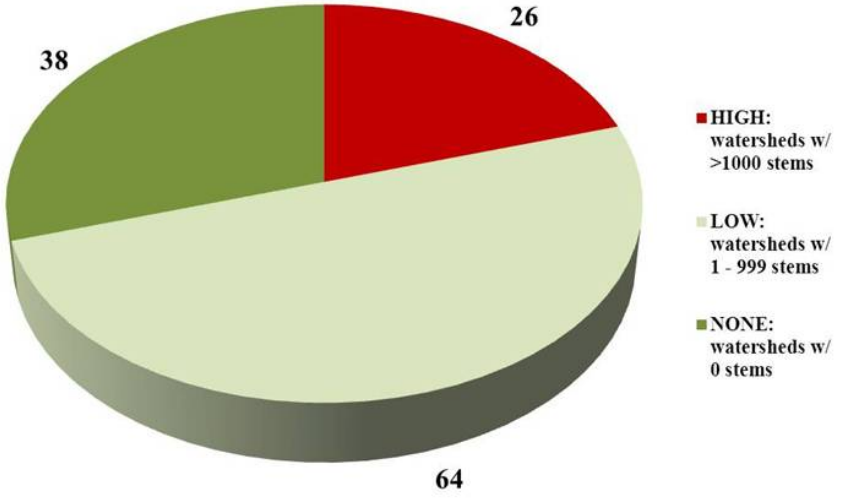
Nez Perce Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

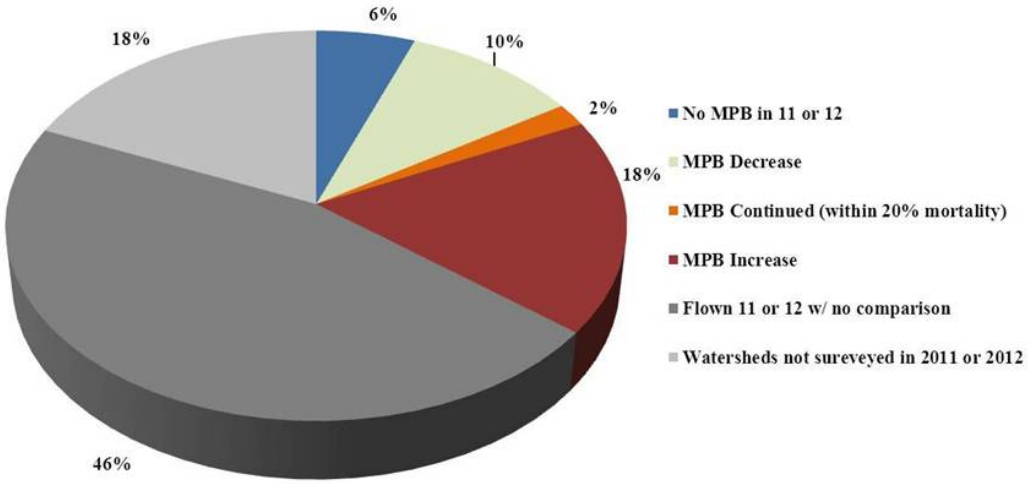
2011
53% subwatershed coverage within reporting area



2012
82% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Lower American River	Increasing
Lower Johns Creek	Increasing
Lower Red River	Increasing
Silver Creek	Increasing
Headwaters Meadow Creek	Decreasing
Twentymile Creek	Decreasing
Upper Newsome Creek	Decreasing

Additional subwatersheds on next page

Nez Perce Reporting Area

MPB trend in 2012 relative to 2011 within Huc-12 subwatersheds that had High MPB intensity detected in 2012

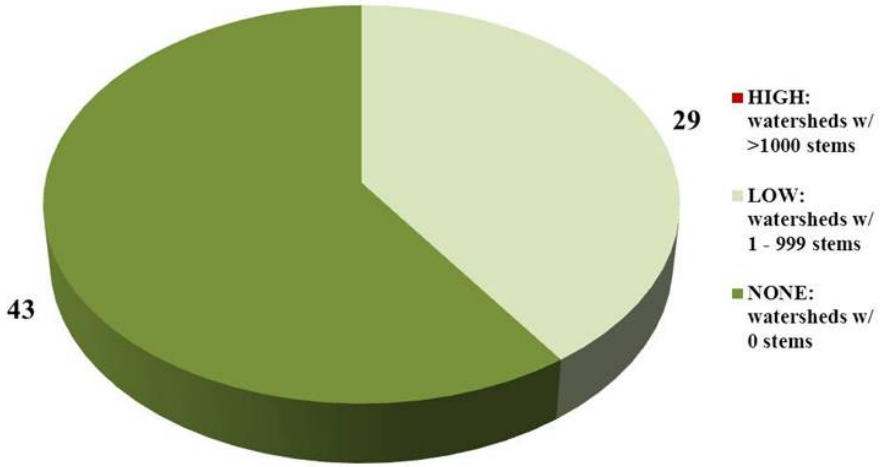
Subwatersheds with High Intensity MPB in 2012
w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Buck Lake Creek	Unknown
Carey Creek-Salmon River	Unknown
Jersey Creek-Salmon River	Unknown
Kelly Creek-Salmon River	Unknown
Lower Little Slate Creek	Unknown
Meadow Creek	Unknown
Upper Little Slate Creek	Unknown
Upper Running Creek	Unknown
Upper Slate Creek	Unknown
Lower Meadow Creek	Unknown
Lower Slate Creek	Unknown
Middle Meadow Creek	Unknown
Mill Creek	Unknown
Ohara Creek	Unknown
Sable Creek	Unknown
Tenmile Creek	Unknown
Upper Bargamin Creek	Unknown
Upper Crooked River	Unknown
Upper Meadow Creek	Unknown

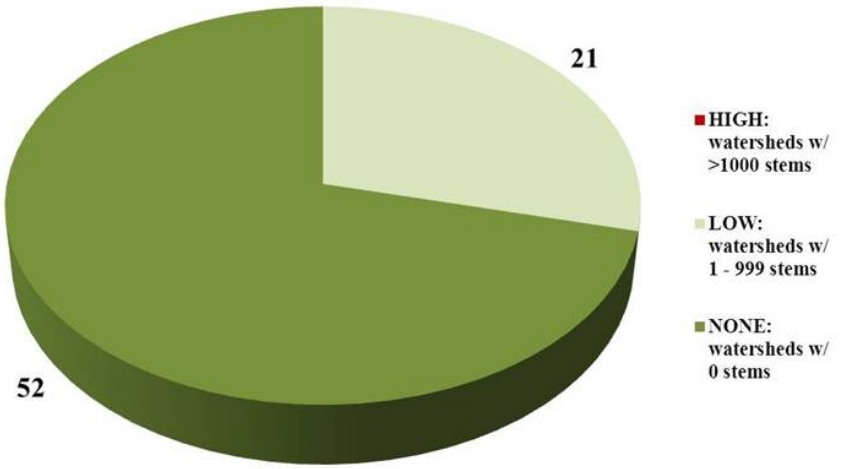
Nez Perce Indian Reservation Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

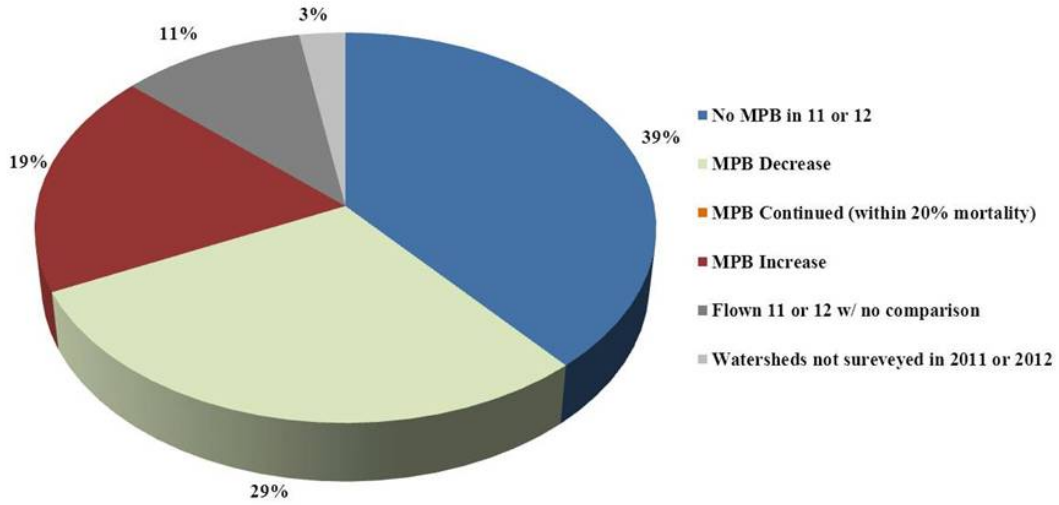
2011
96% subwatershed coverage within reporting area



2012
97% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

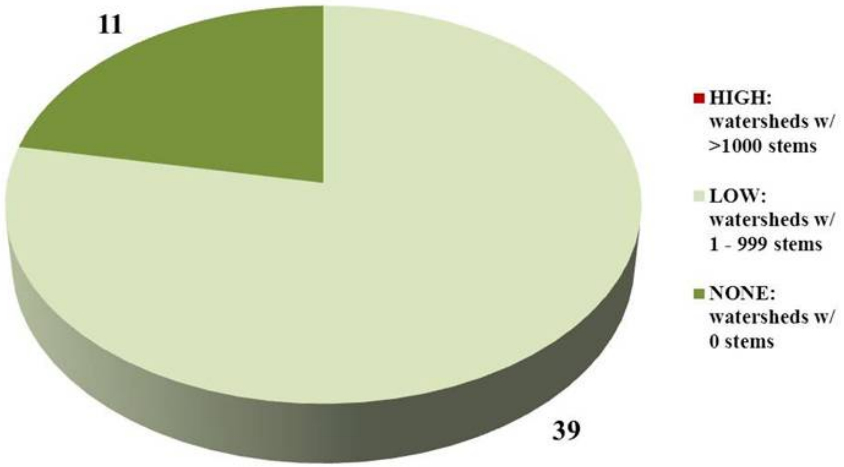
Huc-12 Subwatershed	Trend
No subwatersheds within Reporting Area had high intensity of MPB in 2012	

Northern Cheyenne Indian Reservation Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

2011

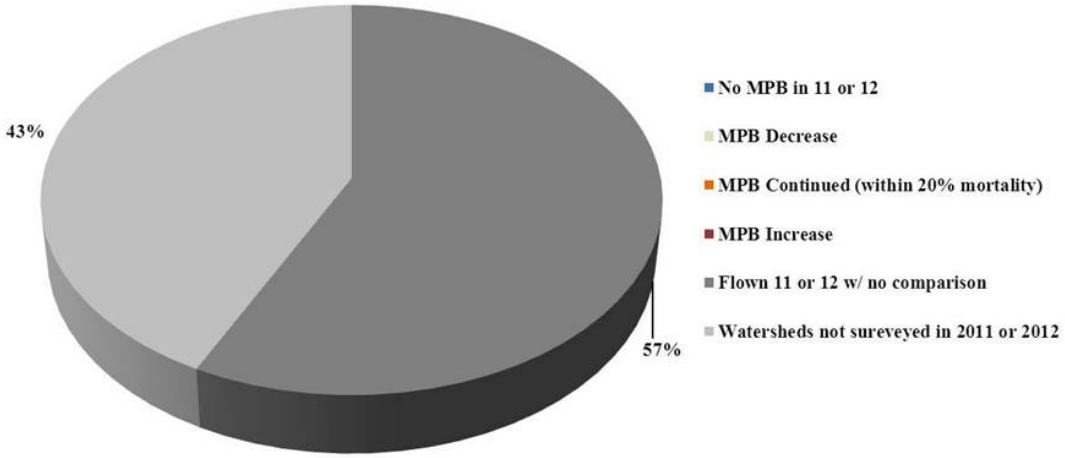
57% subwatershed coverage within reporting area



2012

0% subwatershed coverage within reporting area

Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

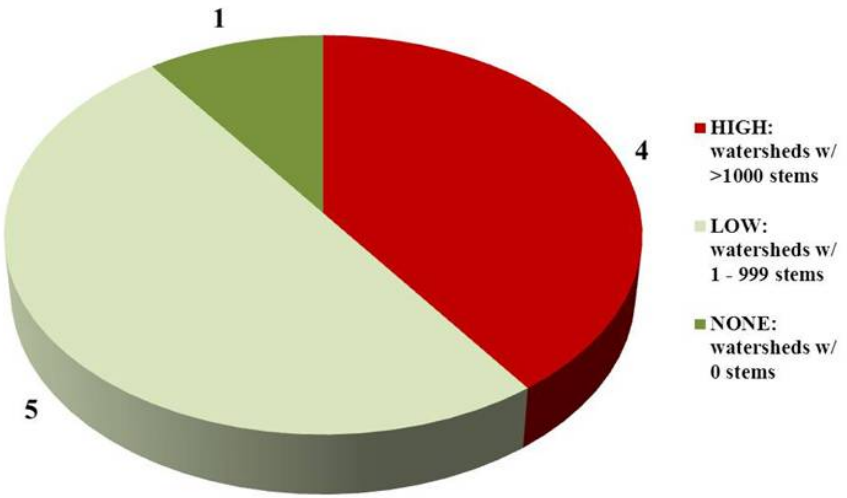
Huc-12 Subwatershed	Trend
No subwatersheds within Reporting Area had high intensity of MPB in 2012	

Rocky Boys Indian Reservation Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

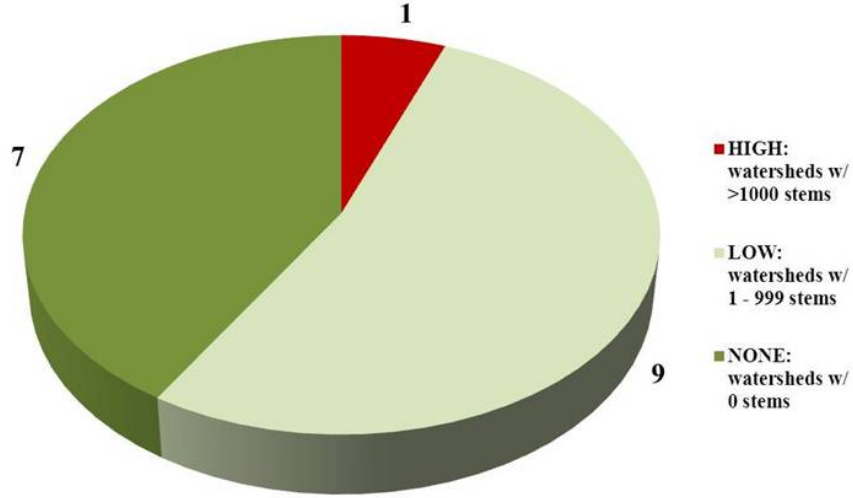
2011

20% subwatershed coverage within reporting area

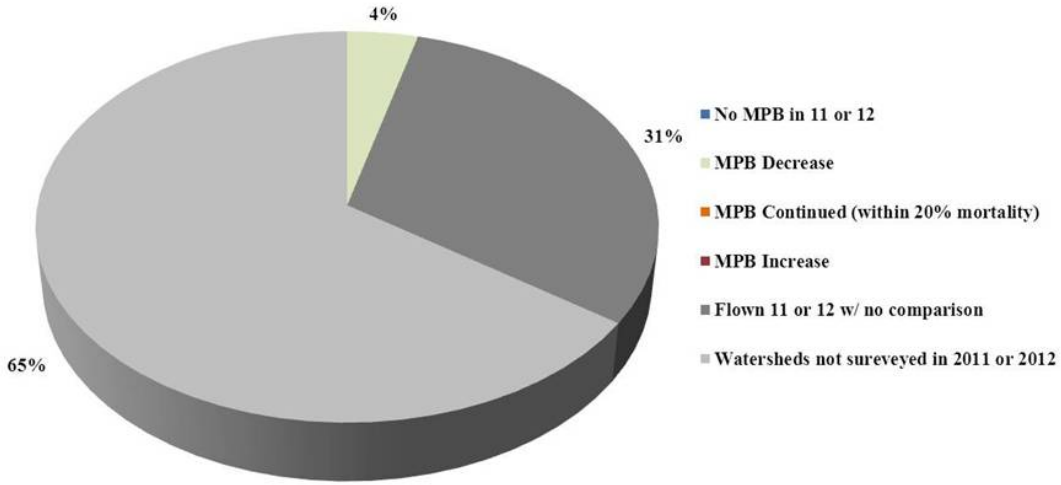


2012

35% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

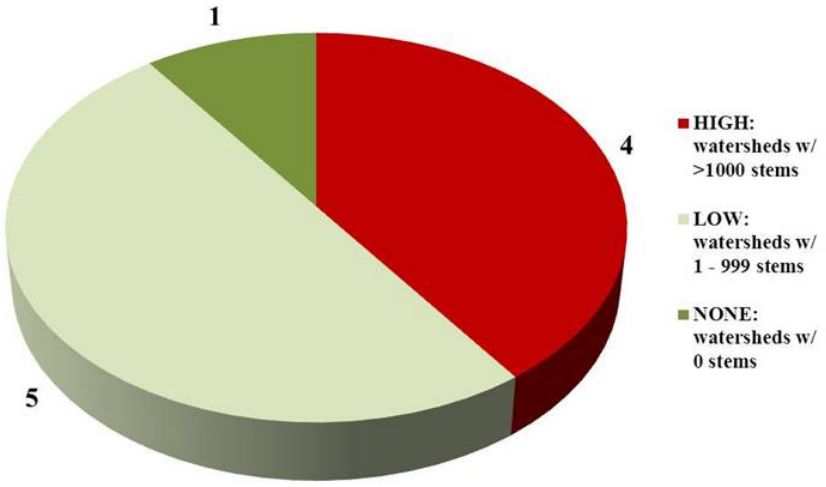
Huc-12 Subwatershed	Trend
Upper Beaver Creek	Unknown

Saint Joe Reporting Area

Number of subwatersheds with intensity of mountain pine beetle-killed stems detected in 2011 and 2012

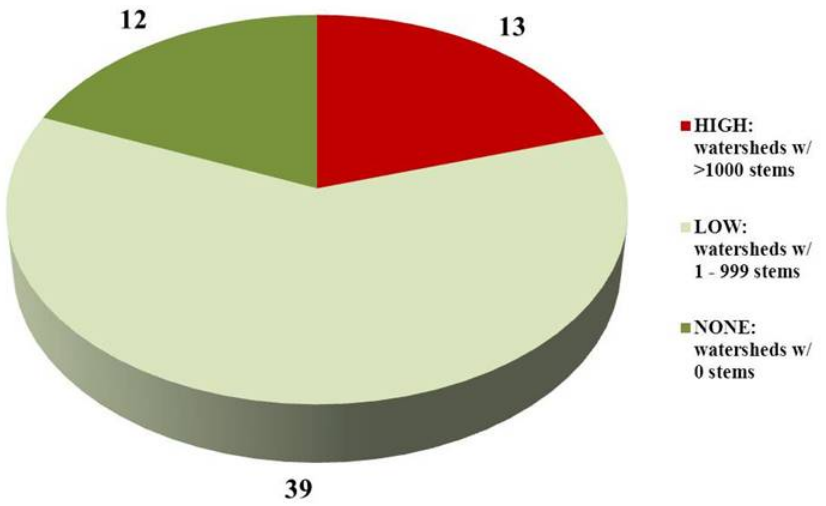
2011

98% subwatershed coverage within reporting area

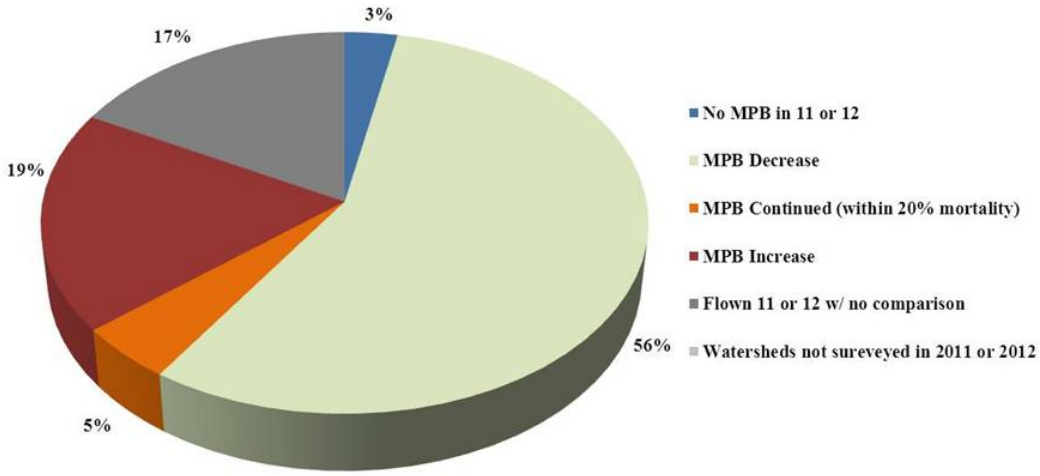


2012

100% subwatershed coverage within reporting area



Mountain pine beetle trend in 2012 relative to 2011 within Huc-12 subwatersheds



Subwatersheds with High Intensity MPB in 2012 w/ Trend Information where Available

Huc-12 Subwatershed	Trend
Bruin Creek-St Joe River	Increasing
Fishhook Creek	Increasing
Simmons Creek	Increasing
Sisters Creek	Increasing
Siwash Creek-St Joe River	Increasing
Bluff Creek	Decreasing
Upper Slate Creek	Decreasing
Sawtooth Creek	Unknown
Bacon Creek-St Joe River	Unknown
Canyon Creek	Unknown
Copper Creek-St Joe River	Unknown
Sherlock Creek-St Joe River	Unknown
Timber Creek-St Joe River	Unknown